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ABSTRACT

A project was conducted to expand a previously developed model for developing proficiency/equivalency tests to evaluate previously acquired knowledge and skill competencies in the areas of clinical microbiology and clinical hematology. Designed for a target group consisting of on-the-job trainees, military personnel, and medical laboratory technicians at the associate degree level, the tests measured competencies already acheived as a prerequisite for placement in an existing medical technology baccalaureate-level program. Project activities included compiling and evaluating level statements of competencies and objectives for clinical microbiology personnel, writing and compiling test questions based on these competencies, and revision and renorming of clinical hematology examinations and will include the norming of the microbiology exam in spring 1982. The design and evaluation phases of the project have been completed successfully, and the dissemination phase is still on-going. (Appended to the report are the content grids, examination forms, and test keys of the microbiology and hematology examinations, a proctor's manual and other procedural forms, and statistical data from the hematology renorming.) (MN)

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FINAL REPORT

OF

AN EXPANSION OF A MODEL FOR DEVELOPMENT OF PROFICIENCY/ EQUIVALENCY TESTS FOR CLINICAL LABORATORY PERSONNEL

1980-81

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CE 030 001

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PROJECT TITLE: Expansion of a Model for Development of Proficiency/Equivalency Tests for Clinical Laboratory Personnel.

LEGAL NAME OF APPLICANT DISTRICT, INSTITUTION OR AGENCY: CMDNJ/School of Allied Health Professions

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ABSTRACT

DESCRIPTION OF PROJECT

(Use this sheet and no more than one other type in single-spaced form a statement of project objectives, procedures to be followed, state and local priorities emphasized and the expected contribution of the project to vocational education.)

The goal of this project was to expand a previously developed model for recognition of competencies already achieved by clinical laboratory personnel for advanced placement in the existing Medical Technology baccalaureate level program at CMDNJ/SAHP. The personnel intended to be the target group include on-the-job trainees, military personnel and Medical Laboratory Technicians at the Associate Degree and Certificate Level. The objectives of the project were accomplished through development of proficiency/equivalency examinations on a Basic (MLT) and Advanced (MT) Level to evaluate previously acquired knowledge and skill competencies in the area of Clinical Microbiology and through the renorming of the revised examinations in the area of Clinical Hematology. Modification of curriculum into Basic (MLT) and Advanced (MT) modules will facilitate entry of target group individuals into MLT and MT programs in the state.

The above goal was achieved by test development in the area of Clinical Microbiology and by the renorming of the revised Clinical Hematology examinations that were developed with FY80 fiscal support from the current funding agency. The specific activities for this project included compiling and evaluating job entry level statements of competencies and objectives for MLTs and MTs in Clinical Microbiology, and writing and compiling test questions of appropriate content and taxonomy level based on these competencies and objectives. The expertise of educational consultants, educators and practitioners in Clinical Laboratory Sciences was utilized in carrying out these activities. A statewide committee of eighteen Clinical Laboratory Sciences educators and practitioners constructed four 200-item examinations, two at each educational level. The norming of these examinations will be conducted statewide in Spring 1982, after which the committee will reconvene to revise and consolidate the exams on the basis of validity and reliability data as well as item analysis accumulated by the norming process. In addition, statewide norming of the revised Clinical Hematology proficiency/equivalency examinations was conducted on 203 of the state's MLT and MT graduating students. These subjects, who comprised approximately 90% of the statewide population, were enrolled in over 20 programs in the state. The renormed examinations were evaluated by an educational consultant and distributed to New Jersey MLT and MT educational programs for advanced placement purposes in this clinical area.

Two Federal priorities were addressed in the project. These are: (1) assisting economically disadvantaged individuals in urban areas to further their education in Clinical Laboratory Sciences and (2) providing incentive and mechanism for the "next step" career option in the clinical laboratory profession. The continuing project represents an extension of the national innovative model in vocational education as was begun last year. It identifies occupational competencies at two educational levels within the same profession. The resulting criterion-referenced examinations measuring previously-acquired educational skills can be used by New Jersey's thirty-four educational programs in Clinical Laboratory Sciences for advanced placement purposes.

Acknowledgements

The project director and coordinator wish to thank the MLT and MT educators of New Jersey and their students for their enthusiastic participation in this project. They are also indebted to the project committee members (Judith Allen, Diane Armington, Madeline Bonadies, John Davis, Robert Del Guidice, Anna Gargantiel, Elaine Keohane, Heidi McGraw, Susan Mikorski, Rennie Miller, Suzanne Roth, Kuldip Sandhu, Jeanette Sanducci, Bruce Storm, Les Stutzman, and Mary C. Wethington). These individuals devoted many hours of free time into making the examinations the professional products that they are. Finally, the massive secretarial effort required to expedite the project was handled most ably by Amanda Cooper, Pamela Turpeau, Deborah Schira, Helen Girardi and Lola Scott.

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I. INTRODUCTION

A. Problem

A point of major concern in Medical Technology(MT) baccalaureate level education is the lack of mechanism for recognition of competencies achieved outside the traditional academic environment or in lower level academic programs in Clinical Laboratory Sciences. Individuals with previous clinical laboratory experiences, either through on-the-job training, military training or formal education (Medical Laboratory Technician - (MLT) at the Associate Degree and Certificate Level) must undergo curricular experiences that duplicate what they already possess in order to pursue their education to the Medical Technology level. Two major reasons for the duplication are 1) lack of acceptable instruments for measuring competencies in Clinical Laboratory Sciences and 2) the lack of flexibility in the traditional Medical Technology Curriculum for advanced placement of these individuals. This presents a problem which has an adverse effect on the students in that their time, efforts and resources are inefficiently utilized through repetition of coursework in which they are already competent. Also, it discourages the student from pursing further education and advancement. This problem is particularly significant in economically deprived individuals with limited time and financial resources who find themselves "locked" into their present positions. At a meeting (January 10, 1979) of educators in Clinical Laboratory Sciences sponsored by the New Jersey Society for Medical Technology, results of a survey of the educators in the state were presented and indicated that the problem was a primary concern, particularly in the case of MLTs. It is now estimated by the N.J. Health Manpower Planning Series that the supply of MLTs will be 1,210, many of whom will elect to pursue their education to the baccalaureate level.

Microbiology competences used by the MT program at the University of Illinois-Peoria. These compiled competencies and objectives were then evaluated and modified where appropriate by the committee.

The content of Clinical Microbiology was then divided into four subtopics (nonfastidious gram negative bacilli and anaerobes, other bacteria including mycobacteria, mycology and parasitology and miscellaneous --specimen collection and processing, quality control, susceptibility testing, epidemiology and safety). Each subtopic was the responsibility of a subcommittee whose composition consisted of a mix of practitioners, MLT and MT educators. Each subcommittee chair was charged with organizing and modifying MLT and MT content areas in their specific subtopic and designing a table of specifications (test grid) from these materials.

2. The second requirement was to construct proficiency/equivalency exams to evaluate students' knowledge and skill competencies at the Basic and Advanced level. Methods described by Schoeff and Ciurczak (1979a, 1979b) were utilized in the construction of criterion-referenced exams using a paper and pencil format. Although Schoeff and Ciurczak used kodachrome transparencies in their examination, the committee concurred that such a strategy was impractical at this time but that illustrations would be useful in certain sections of the exams.

The methodology adopted by the committee for developing the exams at the two levels of competency involved: a) establishing the percentage of questions in terms of content and taxonomy for the Basic and Advanced level exams; b) compiling and designing a pool of multiple choice questions submitted by various educational programs in the State as well as designing new test questions; c) selecting two sets of established number of questions of appropriate content and taxonomy from the pool which

B. Objectives

Schoeff and Ciurczak (1979a) have said the following of on-the-job learning in the Clinical Laboratory Sciences:

> "it is not restricted to academic programs. Individuals through their professional experience develop competencies that equal those developed by students in scholastic curricula."

In keeping with this philosophy, the goal of this project was to expand a previously-developed model for recognition of non-traditional learning experiences in the existing MT program at CMDNJ/SAHP.

The project's original 2 objectives were modified to 3 (see Appendix A) due to reorganization of the project's administration. Thus the three main objectives included:

A. Modification of existing MT Curriculum into a basic and advanced component to facilitate implementation of proficiency/equivalency examinations.

B. Development of proficiency/equivalency exams as mechanisms for advanced placement in the Clinical Microbiology component of a Baccalaureate Degree Program in Medical Technology.

C. Evaluation of previously developed proficiency/equivalency exams in the area of Clinical Hematology as a mechanism for advanced placement in this clinical component of Medical Technology education.

Specific objectives relating to the above were to:

A.1. Evaluate and modify job entry level competencies for clinical laboratory personnel utilizing the expertise of practitioners and educators in this field.

2. Evaluate and modify the educational objectives for student achievement of these competencies.

3. Categorize competencies and objectives into Basic (MLT) and Advanced (MT) components.

B.1. Compile test items for the Basic and Advanced level which reflect appropriate content and taxonomic level to evaluate student achievement of the objectives described for each subject area.

2. Evaluate construction and design of test questions and make revisions where appropriate.

3. Construct two sets of proficiency/equivalency exams at each educational level.

C.1. Renorm Clinical Hematology examinations through administration to MLT and MT graduates.

2. Reevaluate the tests on the basis of item analysis and validity and reliability data.

3. Disseminate information about the examinations throughout the state in order to attract the target population.

C. Definition of Terms

A criterion-referenced examination is one which is deliberately constructed to yield measurements that are directly interpretable in terms of specified performance standards (Glasser and Nitko, 1971). The criterion-referenced examination is not designed to measure individual differences within a group nor to rank such examinees. The test items are specifically designed so that the examiner can determine an examinee's performance on a specific cluster of tasks.

The intent of the project was to design equivalency examinations that were criterion-referenced. Thus, such an examination was intended to measure if an individual's formal or informal work experience was equal to that subsumed in a body of knowledge defined by a peer panel of experts in the field.

D. Related Research or Background Information

Individualized instruction can be structured so that an incoming student is placed in a learning hierarchy before actual teaching begins. Such a placement decision requires three phases: (1) Identification of the curricular objectives; (2) design of a testing program to measure the incoming student's prior completion of such objectives; and (3) construction of measuring instruments to evaluate such achievement information. These achievement data are specific to a particular curricular sequence, to each prerequisite instructional objective with a given sequence, and to a learner's performance in relation to the given sequence and its prerequisities (Glasser and Nitko, 1971). Construction of a curricular map is a logical prepatory phase to such placement evaluation. The placement evaluator can deal with these data in a realistic manner only if the placement test is criterion-referenced, i.e. compared to a standard of performance.

Statistical features and decision processes related to criterion-referenced placement tests focus on proof of the validity of the intended curriculum sequence. If the curriculum is not sequenced, then comprehensive student evaluation of every behavioral objective is necessary. In addition, this hierarchial sequencing assists the educator in devising instructional alternatives for: (1) remediation and (2) advanced study. Such strategies may have varying emphases on the extent of reinforcement, reliance on sensory stimuli, etc. One of the most utilitarian applications of these criterion-referenced approaches to individualized learning is in the arena of equivalency testing (the use of tests to equate knowledge, experience and skills with predetermined formal training levels) and proficiency testing (the matching of individuals with jobs on the basis of measurable ability to perform them).

The Use of Criterion-Referenced Examinations in the Health-Related Occupations

A spectrum of governmental and educational agencies have devoted increasing attention to equivalency and proficiency testing with respect to the alleviation of health manpower shortages. The prime examples of potential manpower pools to fill such gaps are returning military medical corpsmen and on-the-job trained individuals. DHEW expressed this concern in the following:

> "Better utilization and retention of manpower already employed will depend largely upon the success of efforts to enhance career mobility, both vertically and horizontally. This can be accomplished only by removing as many artificial or unnecessary obstacles to advancement and change as possible, consistent with the maintenance of adequate professional standards of service. In turn, the success of these efforts may be enhanced by the availability, efficacy and acceptance of equivalency and proficiency testing programs for health personnel."

From: Equivalency and proficiency testing - a survey of existing testing programs in allied health fields. DHEW: U.S. Printing Office, 432-628-1971.

An ERIC search of the literature revealed few references which described the outcomes of criterion-referenced tests employed with health professionals for educational tracking purposes. These include:

(a) Radiologic Technology - Educational Testing Service (1974) conducted task analyses in six job function areas with the assistance of a national advisory group. A criterion-referenced examination, a curriculum guide, and policies were developed for credentialing at the routine radiographic procedures level.

(b) Occupational Therapy and Therapy Assistant - Professional Examination Service (1975) developed criterion-referenced proficiency examinations at the entry level. External validation proved to be the greatest instrumental handicap.

(c) Respiratory Therapy - The Psychological Corporation (1974) constructed two (one each at the technician and the technologist level) criterion-referenced proficiency examinations. Small sample size precluded use on a national scale.

(d) *Medical Laboratory Science* - Professional Examination Service (1974-77) constructed and administered a proficiency examination in collaboration with U.S. Department of Health, Education and Welfare and with the U.S. Department of Labor. The examination was administered to all clinical laboratory personnel performing medical technologist functions without a baccalaureate degree in the discipline; the instrument was given in all hospital facilities receiving Medicare and Medicaid payments.

(e) *Nursing* - The New York State Regents External Degree Program has constructed a three-day clinical competence proficiency examination for diploma-school and ADN nurses. This often combined with outcomes from the ACT PEP assessment of the nurses theoretical knowledge base.

Philosophy and Utilization of Equivalency Examinations in the Clinical Laboratory Sciences

Wilson (1974) describes equivalency examinations as a most viable direction in providing individuals with academic credit and/or advanced standing for their on-the-job professional experiences. This philosophical stance gave impetus to the design of the DHEW proficiency examination described previously and to CLEP equivalency examinations in the clinical laboratory sciences. Johnston, Dumoff and Shoemaker (1977) administered the CLEP Subject Examinations in Medical Technology to students in ten MT programs and four MLT programs in Missouri; they found that only the clinical microbiology section demonstrated cognitive duplicaton at the two educational levels. Therefore the CLEP Clinical Chemistry, Clinical Hematology and Clinical Immuno-hematology tests measure professional performance at the medical technologist (or baccalaureate) level rather than at the medical laboratory technician (or associate degree) level. At the present time there is no commericallyavailable instrument which evaluates competency at the lower entry-level position, i.e. technician, of this health profession. Amos (1972) has advocated one strategy for programmatic soundness in the clinical laboratory sciences educational process. This strategy is a hierarchial approach in which economy of teaching time and effort could be maximized by modularizing the curriculum so that skills are taught first and theory and synthesizing abilities are taught later. Such a route must be prefaced by a task analysis of the skills and theoretical bases of each of the two levels of practitioners. The first attempt to construct a curriculum which has this philosophical soundness of career mobility in the clinical laboratory sciences was reported by Schoeff and Ciurczk (1979a, 1979b). The former author has implemented a "2+2" integrated medical technology program at the University of Illinois (Peoria) which confers one full year of academic credit to incoming MLTs when they take a 430-item equivalency examination. Normally such indivuduals would be required to take an additional year of courses because credit for their clinically-based courses is often lost in the transfer process. The paper and pencil examination was criterion-referenced by a group of 30 MLT and MT educators in the state and then normed nationally in 1978.

Equivalency examinations in this health profession discipline might also be employed to provide advanced standing for on-the-job trained and military personnel with clinical laboratory experience wishing to enter a formal medical technology educational program. Dietrich (unpublished, 1977) suggested that enrichment courses, internships and independent study are viable alternatives for the introductory skills and theory sections of the major professional courses.

II. BODY OF REPORT

A. Procedures - Microbiology Examinations

A systematic approach was utilized for development of a mechanism for recognition of non-traditional learning experience by the existing MT program. One subject area, i.e. Clinical Microbiology, was targeted to augment the existing model in Clinical Hematology already developed by this Project Director.

1. The first requirement was to form a committee of experts in the education and practice of Clinical Microbiology. In addition to the project director and coordinator, the committee was composed of two MLT educators, seven MT educators and seven practitioners from a Clinical Microbiology laboratory setting.

The committee's first task was to identify and organize MLT and MT competencies and objectives in this discipline utilizing published and unpublished research and a 1979 study of job entry level competencies for MLTs and MTs conducted by the American Society for Medical Technology (ASMT). In addition, three recently developed and published source documents of ASMT were used. They were, "Body of Knowledge," which identifies the comprehensive competencies of Clinical Laboratory practitioners in each specialty, and two societal position papers, i.e. "The Scope of Practice of the Clinical Laboratory Sciences" and "The Level of Practice of the Clinical Laboratory Sciences" (Mass, 1980). Other information sources used by the committee were: (1) the ASCP Content and Grid for the Clinical Microbiology section of the MLT and MT level Certifying examinations; (2) course objectives in Clinical Microbiology provided by the Medical Technology Programs at CMDNJ-SAHP, MetPath, Somerset Medical Center and Monmouth Medical Center and the Medical Laboratory Technician Program at Felician Collge; (3) MT related directly to the previously identified competencies and outcomes to provide addtional test questions that would be evaluated by item analysis of a form "A" and "B" at each level, and d) criterion-referencing and determining the Minimum Pass Level for each set of exams.

The five steps in criterion-referencing were:

(1) Defining the appropriate weights of taxonomic levels.

The chosen levels were recall, interpretation and problem-solving for both levels of the educational hierarchy. The weighing systems for the MT and MLT exams, determined by committee consensus, were:

	MLT	MT
Recall	55%	25%
Interpretation	35%	40%
Problem-solving	10%	35%

The committee chose to equally weigh each of the four content areas of Clinical Microbiology in terms of the percentage of items to be included on the examinations. A further division of content areas in terms of percentages was established to reflect the "more" clinically significant knowledge needed at entry level. This division of content areas resulted in the following:

Group 1	Bacteriology	Gram Negative Nonfastidious 70% Anaerobes 30%
Group 2	Bacteriology	Other Bacteria (left to subcommittee for breakdown) (see Appendix C1)
Group 3	Mycology 40% Parasitology 60%	
Group 4	Miscellaneous	Susceptibility & Specimen Processing 70% Other 30%

(2) Selecting 200 items from the established pool of questions for each of the examinations constructed.

Each of the subcommittees drafted 100 questions for the MLT and 100 questions for the MT examinations in their content area. These questions were divided into an A and a B form of the examination at each level.

(3) Instructing committee members in the construction of criterion-referenced examinations.

The project coordinator presented a one-day workshop for the committee members to instruct them on item construction and the basic assumptions of a criterion-referenced test.

(4) Criterion-referencing by the subcommittees.

The subcommittee members met independently between April 1981 and June 1981 to refine their content grids, write test items, match items to the test grid and establish a minimum pass index for each test question using standardized forms prepared by the project coordinator.

The minimum pass index (MPI) for each multiple choice item was computed as follows: (a) a weight of "2" was assigned to the one best answer; (b) the remaining answers were classified according to the degree of difficulty they present to the minimally competent student, i.e. one who has just sufficient understanding of the essential facts and concepts to be certified as proficient in the theory of Clinical Microbiology. A "0" was assigned to those answers which such a student should be expected to recognize as incorrect and therefore be able to avoid. A "1" was assigned to those answers which the minimally competent student may or may not be able to eliminate. A "2" was assigned to those answers which the minimally competent student should not be expected to recognize as incorrect. The MPI represents an estimate of that item's difficulty in terms of the probability that a minimally competent student would answer it correctly and was further computed by dividing 2 by the sum of the item's difficulty codes. More difficult items would thus receive a lower MPI. The Minimum Pass Level (MPL) for such an examination is the sum of the MPIs for the items. It is the lowest score a student could receive in order to be determined as competent in Clinical Microbiology.

(5) Peer-reviewing of test questions and MPIs.

The committee convened in June 1981 to examine the structure of each item, check the correct response and reaffirm the appropriateness of the MPI for the items. An additional logistical decision related to the examinations included a sequencing of items from lowest taxonomy level to highest taxonomy level within each item cluster as was done in the construction of the Clinical Hematology examinations.

3. The third requirement, to establish the validity and reliability of the exams, will be conducted statewide in Spring, 1982, by CMDNJ-SAHP. At that time the exams will be computer tabulated as to test validity and reliability. Item analysis data will be available to the committee when they reconvene in June 1982 to select the best items according to item analysis matched against the content grids and to revise each item MPI upward or downward based on such data.

B. Procedure - Hematology Examinations

The validity and reliability of the Clinical Hematology exams developed with FY80 fiscal support from the current funding agency was established through renorming. The renorming process was conducted in a similar fashion to the original norming last year, which included: 1) contacting programs to participate in the renorming; 2) using a two-digit institutional code and the student's social security number as identifiers; 3) mailing the examination packet about one week prior to the test date of April 28, 1981, to each cooperating institution with instructions, a checklist of enclosures, a Proctor's Manual, the examinations in a sealed envelope, IBM sheets inserted into each exam booklet and a prestamped, self-addressed manila envelope for immediate exam return; and 4) telephoning each institution to assure delivery.

The revised exams were scored and computer analyzed. An evaluation of the data was made by a representative of the Educational Testing Services, Princeton, New Jersey. This same educational consultant was employed last year for evaluating the initial forms "A" and "B: of each examination (MLT and MT). His function was to critique the test outcomes and review the newly generated item analyses. His report along with the final revised exams in Clinical Hematology were distributed in June 1981 to the MLT and MT educational programs in New Jersey for implementation into their programs as they see fit.

The advanced placement process is now available in Clinical Hematology at CMDNJ-SAHP. Applicants with previous Clinical Hematology Laboratory experience who are selected into the MT Program will have the opportunity to take the Basic and Advanced Level Exams. Students must first successfully pass the Basic Level Exam in order to take the Advanced Level Exam. Successful completion of either examination will result in the waiving of the corresponding component in the MT curriculum. The successful student will be counselled and given several options: a) participation in research projects, b) learning specialized techniques or procedures, or c) utilizing their time for part-time employment. Arrangements for the enrichment activities (a & b) will be made with other departments and specialized laboratories, as well as various research and laboratory facilities in New Jersey.

C. Project Outcomes

1. Content Grids. The content grids for the various disciplinary topics in Clinical Microbiology at each academic level are included in Appendix C1.

2. Initial Examination Forms for Clinical Microbiology. Forms A and B of the initial examination at each academic level are included in Appendix C2. The MPI lists which follow each examination are relatively high values since a rounding upwards produced cut-off points of 140 for MLT-A, 168 for MLT-B, 154 for MT-A and 142 for MT-B. The exams are ready at this time for the norming that will be conducted Spring, 1982 (the next graduating class of MLT and MT students).

3. Final Hematology Proficiency/Equivalency Exams. The revised version of the Clinical Hematology examinations are included in Appendix D1, along with the revised MPI lists for each examination as was designed last year. The final MPLs that were selected were 76 for MLT and 77 for MT based on the aforementioned procedures. A total of 79 students took the MLT exam and 124 MT students took the MT exam on April 28, 1981. These 203 subjects were enrolled in the following MT and MLT programs. Nine of the state's 13 MLT (69%) and 15 of the state's 21 MT(72%) programs took part in this renorming.

Medical Laboratory Technician Programs (MLT)

Atlantic Community College (MLT-AD)
Bergen Community College (MLT-AD)
Community Memorial Hospital (MLT-C)
Felician College (MLT-AD)
Greater Paterson General Hospital (MLT-C)
Mercer County Community College (MLT-AD)
Our Lady of Lourdes Hospital (MLT-AD)
Riverside Hospital (MLT-C)
Union County Technical Institute (MLT-AD)

Medical Technology Programs (MT)

College of Medicine & Dentistry of New Jersey
Cooper Medical Center
Jersey Shore Medical Center
MetPath Institute for Medical Education
Monmouth Medical Center
Morristown Memorial Hospital
Mountainside Hospital
Muhlenberg Hospital
Newark Beth Israel Medical Center
Medical Center at Princeton
St. Frances Medical Center
St. Mary's Hospital (Passaic)
St. Joseph's Hospital and Medical Center
Somerset Medical Center
West Jersey Hospital

The number of students passing each examination was 56 (71%) for the MLT examination and 54 (44%) for the MT examination. The MPL on the Schoeff and Ciurczak Hematology examination of 110 items to evaluate MLT competency was 79 and 38 (9.6%) of the students in their norming pool achieved this cut-off point successfully. The latter did not have alternate forms with which to design a revised version.

4. Reliability/Validity and Item Analysis Data. The outcomes of the Clinical Hematology examinations with respect to reliability are listed below.

	MLT	MT
K.R. 20	.89	.87
Standard Error	4.41	4.86
Mean	83.5	74.4
Median	82.5	74.5
Standard Deviation	13.55	13.32
Range	49-110	45-98

The difficulty of the MT exam is reflected in the fact that the mean and median are lower than the cut-off point for the test. The Kuder-Richardson reliability values were consistent and comparable to the Schoeff-Ciurczak value of 0.87. A final critique and evaluation summary comparing and contrasting this year's renorming and last year's initial norming of the Clinical Hematology exams can be found in Appendix F2.

Item analysis for each exam is included in Appendix F1. The item analysis was based on ranking of subjects into highest and lowest quintile. It should be noted that the item difficulty has greater relevance than item discrimination in a criterion-referenced examination since all examinees are assumed to be minimally competent rather than distributed in a Gaussian fashion.

5. Proctors' Reports. Examination proctors were asked to critique the receptivity of the students to the test by means of a form included in Appendix F3. A summary of their comments is also found in Appendix F3. Overall student reaction to the exam was positive. The average student was able to complete the test in about ninety minutes, the same average time as with the initial norming, suggesting that speediness did not affect the test outcomes. The proctors appreciated the thoroughness and clarity of the Proctor's Manual which was adapted from that of Schoeff and Ciurczak. No major problems occurred with respect to the distribution of the examinations by mail and followup telephone communication to assure receipt. Return of materials via prestamped manila envelopes proved satisfactory.

D. Interpretation of Findings

1. Construction of a Clinical Microbiology equivalency examination for individuals at the Basic and Advanced Levels.

The content definitions in the tables of specifications were designed to reflect entry-level job functions of Clinical Laboratory personnel as they exist in New Jersey. It should be emphasized that the advanced-level of personnel is expected to operate at a higher taxonomic level than basic-level personnel. However, this is also a function of manpower supply and demand so that a MLT may function at a cognitive and/or psychomotor level of a MT if there are shortages of personnel. The same logic applies to on-the-job trained individuals.

The committee wanted four subcommittee with each responsible for an equal share of the tasks. It was felt that the subject area of Bacteriology would be divided among two of these subcommittees and the remaining topics in the third and fourth subcommittee. In addition, each content area would have a similar pattern of emphasis on recall, interpretation and problem-solving. This may not be an accurate reflection of entry-level knowledge due to the great variation in geographical and institutional performance of the art with respect to each of the content areas, however, the committee was satisfied with their decisions. The committee demonstrated initative and much fore-thought in defining various parameters it would use in designing the examinations as reflected in the discussions concerning percent distribution of taxonomy levels, specialty areas relevant to Clinical Microbiology and the weights of content within subcommittees (see Minutes, March 19, 1981 in Appendix B).

The collapsing of the cognitive domain into three hierachial levels facilitated test construction since a number of the committee members had not used a table of specifications prior to this time. However, this may not be a problem because of the higher number of interpretation and problem solving questions as compared to that employed in writing the Hematology

A conceptual problem in the project's test construction involves the sole reliance on a written examination as a test for competency. An ideal instrument would have a paper-and-pencil component, kodachrome slides and a proficiency element using actual specimens and laboratory equipment. The feasibility of this approach was not able to be explored with the limited resources in the project. The capabilities and expertise of NOCTE might be used in the future to refine such a test format since a national examination requiring demonstration of a candidate's skills in the Clinical Laboratory Sciences has not yet been developed.

The use of an alternate form approach for the future norming process will hopefully prove invaluable in giving the committee a larger item analysis data base to evaluate. Future committees should continue to consider these parallel forms, especially if the norming population can be increased in size.

2. Establishment of reliability and conduct of item analysis on the revised Clinical Hematology examinations.

The reliability data on each examination are adequate. Since there was a downward adjustment, i.e. assignment of a lower difficulty level, to the item distractors on the revised examinations, the actual number of students passing the New Jersey examinations was expected to increase and this actually did occur.

		# passing	average
initial forms	MLT-A	11 (24%)	= 28%
	MLT-B	16 (33%)	
revised form	MLT	56 (71%)	

		# passing	average
initial forms	MT-A	7 (9.3%)	= 33%
	MT-B	38 (57%)	
revised form	MT	54 (44%)	

Schoeff and Ciurczak's peer committee, however, made their revised items easier, thus lowering the minimum pass level and increasing the likelihood

The item analysis data on the exams revealed that most items met the stated criteria of a difficulty level of 40-70% and a point biserial coefficient of greater than .20 as reflected in the Consultant's report (Appendix F2).

Schoeff and Ciurczak have reiterated some of the limitations of the norming stratgies of this type of project; (a) "graduating" MLTs and MTs are used in the norming. Individuals who are on-the-job trained may have considerably more competence if they also have extensive work experience. (This would be particularly true if a practical component were added to the test battery.) The most appropriate norming would have been on individuals with on-the-job training but insufficient numbers of such subjects were available in the state. (b) MLT and MT programs accredited by AMA-CAHEA are likely to have more homogeneous curricula. Most MT programs have such accreditation but this is not always true of the MT programs. (c) a practical element, including laboratory simulation, kodachromes, etc., should be included in the norming process.

In light of the limitations stated by Schoeff and Ciurczak, an attempt was made to keep our norming population as homogenous as possible. Of the nine MLT programs participating in the renorming process, 3 were MLT-C, i.e. hospital-based that award certificates of completion, and 5 were MLT-AD programs that are community college-based and award an Associate Degree. Of the fifteen participating MT programs, 14 were 3+1, i.e. 3 years of college studies including prerequisites with 1 year of didactic and clinical internship in a clinical laboratory facility and one program was a 4+1 indicating completion of a Baccalaureate degree before entry into the internship program. In addition, in the Clinical Microbiology examinations, illustrations were used to evaluate recognition and perception skills thereby incorporating a practical element in the student evaluation.

3. Implementation of the advanced placement process for individuals passing the equivalency examination.

The MT program faculty at CMDNJ-SAHP will provide optional experiences which might be substituted for the basic and/or advanced components should an applicant pass the respective equivalency examination(s). These would include: (1) research projects--by working on applied research in the Hematology laboratory of CMDNJ's College Hospital, conducting literature reviews, etc.; (2) specialized techniques or procedures--by rotating through clinical laboratory sections dealing with Tissue Typing, Cytogenetics, Radioimmunoassay, etc.; and (3) utilizing time for part-time employment. The revamping of the Clinical Hematology course objectives in the School's MT Program will facilitate testing and placement. Similar-type activities will be indentified in the area of Clinical Microbiology. However, these will not be implemented until the norming and renorming processes have been completed.

Plans are being made to discuss utilization of the examinations and implementation of advanced placement with the MLT and MT programs in the state this year at the Educational Coordinators' meetings sponsored by the New Jersey Society for Medical Technology. This is essential if applicants to other MLT and MT programs in the state intend to seek advanced placement. Such implementation would be facilitated by: (1) a convening of the educational coordinators of the state's MLT and MT programs along with practitioners to identify the kinds of activities which might be possible in each institutional setting, or those which might be feasible through the cooperation of two or more institutions; and (2) group decision-making on a publicity campaign indicating that this challenge examination route is possible. This might be accomplished by developing a brochure listing all cooperating MLT and MT programs to be appended to recruitment materials and program applications.

E. Dissemination Activities Planned and/or Implemented.

1. The renormed Clinical Hematology exams, computer data and consultant's report have been mailed to the MLT and MT program coordinators at the institutions which participated in the renorming.

2. The final report of the Clinical Microbiology portion of this project will be mailed only to the committee members at this time in order to ensure some degree of confidentiality until the examinations are normed in Spring, 1982.

3. Meetings with the MLT and MT Educational Coordinators in the state at a New Jersey Society for Medical Technology's Educational Section will be conducted during 1981-82 for the purpose of obtaining their interest and cooperation in: (a) the norming of the Microbiology Proficiency/Equivalency exams; (b) discussing effective use of the examinations for advanced placement; (c) modifying existing MT curriculum into modules reflecting two levels of competency (MLT and MT); and (d) identifying enrichment activities for the advanced placement of students.

4. Presentation of this project at state and national level as well as publications will be made during 1981-82.

5. The participating educational coordinators were mailed the total scores and percentile ranks of each of their students. In addition, each student was mailed his/her total score. Thus, the test also served as an educational tool to both the educators and students.

F. Strategies or Activities Employed to Eliminate Sex Bias and Sex Role Stereotyping.

The policies now governing student selection into the CMDNJ-SAHP Medical Technology Program are consistent with the School's policy to admit and retain a heterogeneous student population with emphasis on qualified minority, disadvantaged and handicapped students. These policies will extend to applicants intending to take the equivalency examination described in this project. Publicity about the effort will contain a statement about elimination of sex bias for those programs intending to test applicants with it.

III. SUMMARY

A. Conclusions

The intent of the project, namely, the design of an equivalency examination at two academic levels of the Clinical Laboratory Sciences in the area of Clinical Microbiology and the final evaluation of an equivalency examination in Clinical Hematology, was accomplished. Dissemination is still on going.

1. A Clinical Laboratory Science curriculum was reorganized into Basic and Advanced components for the purpose of examination development.

2. Adequate reliability levels and item analysis outcomes were achieved in the final evaluation of the Clinical Hematology examination instruments.

3. Through participation in this project, it was possible to achieve consensus and cooperation of MLT and MT educators as well as practitioners throughout the state on issues of mutual concern.

B. Recommendations

1. There is an immediate need to extend such examination development into other clinical laboratory areas (i.e. Chemistry and Immunohematology) as well as to expand the testing format so as to include a more practical element which has psychomotor aspects, i.e. laboratory simulations and kodachromes.

2. An assessment of the reliability of the minimum pass level with respect to the criterion-referenced examinations designed in Clinical Microbiology should be made through norming and evaluation of statistical analyses.

3. Greater focus should be placed on the development of alternative experiences for advanced placement.

4. Parallel forms of each instrument provide a greater item analysis pool from which the committee can select questions for a revised instrument. This necessitates considerable long range planning in order to obtain a sufficiently large population for the norming process.

5. Efforts should be made to begin norming data collection, if possible, on returning veterans and on-the-job trained individuals rather than relying solely on test norms based on graduating MLT and MT students who may not have had clinical work experience.

6. The project's budget, as revised, proved fairly realistic in terms of personal expenses, clerical costs and duplicating. However, more consideration needs to be taken for the increasing cost of dissemination of materials including these duplicating expenses and the rising postal rates as well as travel costs for the purpose of dissemination.

Supplementary

Pages

Bibliography

Appendix

BIBLIOGRAPHY

_____. Equivalency and proficiency testing - a survey of existing testing programs in allied health and other health fields. Washington, D.C.: U.S. Printing Office, 1971, (432-628-3121)

_____. Development of occupational therapy proficiency examinations. Therapist level, assistant level. (Final report). New York, N.Y.: Professional Examination Services, 1975.

_____. Development of proficiency examinations and procedures for two levels of respiratory therapy personnel. (Final report). New York, N.Y.: Psychological Corporation, 1974.

_____. Delineation of roles and functions of diagnostic technology personnel and development of proficiency tests. (Final report). Princeton, N.J.: Educational Testing Service, 1974.

_____. The internal validation of Level II and II respiratory therapy examinations. (Final report). Amer. Assn. for Resp. Ther.: Dallax, TX, 1976.

Amos, P.A. Career mobility in the clinical laboratory. Amer. J. Med. Tech., 38: 42-47, 1972.

Dietrich, M.C. A characterization study of the student medical laboratory technology and medical technology majors of New York State. (unpublished dissertation). SUNY/Buffalo, N.Y., 1977.

Glasser, R. and A.J. Nitko. "Measurement in Learning and Instruction." From: Thorndike, R. (ed.) Educational Measurement, (2nd ed.). Washington, D.C.: American Council on Education, 1971.

Johnson, V., N. Dumoff and E. Shoemaker. A comparative study of CLEP scores between MT and MLT students. Amer. J. Med. Tech. 43: 411-16, 1977.

Mass, D. House adopts position papers: Scope of Practice. Levels of Practice. Amer. J. Med. Tech. 46: 810-12, 1980.

Schoeff, L. and F. Ciurczak. Construction and validation of an equivalency examination for an MLT/MT career mobility curriculum. Amer. J. Med. Tech. 46: 51-57, 1980.

Schoeff, L., A. Maturen, G. Fritsma, and K. Srugys. A career mobility option within a university-intergrated medical technology program. J. All. Heal. 7, Spring, 1979.

Wilson, M. Equivalency testing in development of health practitioners. J. All. Heal. 3: 103-9, Spring, 1974.

APPENDIX

Section	Content
A	Correspondence as relates to project revision
B	Minutes of committee meetings
C	Microbiology Examinations
1	Content Grids
2	Examination Forms
3	Test Keys
D	Hematology Examinations
1	Examination Forms
2	Test Keys
E	Proctor's Manual and Other Procedural Forms
1	Proctor's manual
2	Forms used
F	Statistical Data from hematology renorming
1	Item Analysis and Summary of Test Statistics
2	Educational Consultant's Report
3	Protors' Summary Report

COLLEGE OF MEDICINE AND DENTISTRY OF NEW JERS

SCHOOL OF ALLIED HEALTH PROFESSIONS

100 BERGEN STREET / NEWARK, NEW JERSEY 07103

February 6, 1981

201-292-6325

Mr. Thomas Gambino, Coordinator
Exemplary & Innovation Grants
Vocational-Technical Education Division
Department of Education, State of N.J.
225 West State Street
Trenton, New Jersey

Dear Mr. Gambino:

This is in reference to the Project, "Expansion of a Model for Development of Proficiency/Equivalency Tests for Clinical Laboratory Personnel", funded through your Department for 1980-81.

Due to a series of circumstances, such as resignation of Dr. Marie Dietrich and family problems of indvidual recruited for the project, we were delayed in communicating with you sooner.

Presently, we are in a position to carry on the project with few minor revisions for which we are requesting your approval.

~~The revisions are as follows:~~

Project Activities

1. Revise project timetable for development of MLT and MT Microbiology Proficiency/Equivalency exams to include:

    - Shortening the project duration: February, 1981 - June 1981

    - Completing exam construction by June 1981 - Due to time constraints, it is not feasible for committees to construct questions by April for norming with graduating MLTs and MTs in May, 1981.

    - Norming Microbiology exams in May, 1982 - A proposal for continuation of grant to norm Microbiology exams, as well as to develop Proficiency/Equivalency exams in Blood Bank/Immunology will be submitted for 1981-1982.

2. In May, 1981, renorm Hematology Proficiency/Equivalency Exam developed in 1979-80 in lieu of norming the Microbiology Proficiency/Equivalency exam.

   In 1979-80, two Hematology Proficiency/Equivalency exams (Form A & B) were developed and normed for each level of clinical laboratory personnel (MLT and MT). The project was funded under Section 132 of Public Law 94-482. Based on computer analysis of test results, problem items were eliminated and questions from Form A and B were combined to make one exam at each level. This process is described in the final grant report for the 1979-80 project.

   Renorming the revised MLT and MT examinations will ensure that the item revisions have improved the quality of the tests.

Project Personnel:

Project Director

Marie C. Dietrich, MT(ASCP), Ph.D. - resigned as project co-director

Hannah D. Zane, MT(ASCP), M.S. - will assume all responsibilities of project director as stated in proposal.

Project Education Staff

Madeline Ducate, MT(ASCP), M.S. (see CV-Enclosure I) - will assume responsibilities of project consultant as stated in proposal; in addition, Ms. Ducate will contract for secretarial services, as needed, within the framework of the budgeted amount for Project Education Staff.

Educational Consultants

Larry Schoeff will be deleted from the project.

Consultant (from private educational testing firm) - will provide recommendation to the project staff with respect to renorming of the Hematology Exam.

MT Instructor

Elaine M. Keohane MT(ASCP), M.S. - will assume responsibilties as stated in the proposal; request for funding revised from 0 to 5% of position.

Secretary

Amanda Cooper - request for funding for 35% of full-time position; will assume responsibilities as stated in proposal.

A

Project Budget:

No revisions are requested in amount funded for supplies and travel. Revision is requested for funding of grant personnel as indicated in Revised Budget Summary (Enclosure II).

I hope that these revisions meet your approval. Due to time constraints, I would appreciate your prompt response.

Very truly yours,

Hannah D. Zane

Hannah D. Zane, MT(ASCP), M.S.
Chairman, Department of Clinical Laboratory Sciences
CMDNJ/SAHP

HDZ:ac

cc: Dr. Martin
Ms. Lois Graham
Ms. Nancy Moore

Enclosure II A

REVISED BUDGET SUMMARY

	Proposed	Funded	Revised
Salaries			
Project Co-Direct I	no funding requested		10% time
Project Co-Director II	-		resigned
MT Instructor $72.72/day* x 18 days (6hrs/day)	-		$1,309
Project Secretary $59.22/day* x 60.6 days (7hrs/day)	$6,017		$3,588 ✓
Project Education Staff	6,000		~~$5,000~~
Project consultant: $100/day x 40 days (6hrs/day)	?		$4,000
secretarial assistance: $49/day x 40 days (7hrs/day)			$1,960
Educational Consultants $100/day x 4.5 days	$ 750		$ 450
	$12,767	$11,307	$11,307
Supplies	$ 2,461	$2,000	~~None~~ No revisi requ
Travel	$ 2,395	$ 690	~~None~~ No Revisi reques
	$17,623	$13,997	~~None~~ No revis reque

benefits

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MINUTES OF COMMITTEE MEETING

THURSDAY, MARCH 19, 1981
CMDNJ Newark, New Jersey

In attendance: Madeline Bonadies, John C. Davis, Anna Gargantiel, Elaine Keohane, Heidi McGraw, Susan Mikorski, Kuldip Sandhu, Jeanette Sanducci, Bruce Storm, Les Stutzman, Mary C. Wethington, Hannah Zane, Madeline Ducate

Absent: Judith Allen, Diane Armington, Carolyn Eau Claire, Joseph Jaloway, Anne Loving, Rennie Miller, Kathleen Reilly, Daniel Seidel

The first meeting of the MLT/MT microbiology examination committee was held at 3:15 pm on Thursday, March 19, 1981 at CMDNJ with Madeline Ducate presiding and opening remarks and welcome from Hannah Zane. The purpose of this session was to present the overall directions for the project and to obtain group consensus on several issues regarding construction of the examinations.

Hannah Zane gave a brief overview of how the project was developed. Reading from the grant proposal, Ms. Zane explained that because of the lack of a mechanism for recognition of competencies at the MLT and MT levels and lack of flexibility in MLT and MT curriculums to alter or adjust their programs for student's with experience that the MLT/MT proficiency/equivalency exams project was conceived. Last year a model instrument (eg proficiency exams) was developed for Hematology. This year a grant was submitted and accepted to continue the process of developing and evaluating the instruments in the area of Microbiology. She then reviewed the objectives of the project and the time schedule (attached). A The meeting was turned over to Madeline Ducate, Project Coordinator.

Ms. Ducate defined competency and other terms that will be utilized in this project. She passed out two articles that will serve as a basis for the frame work of writing the test items. (attachment B & C). The Position Paper of ASMT on Scope of Practice (Attachment C) was discussed carefully, in order to establish the conceptual differences in competency between the MLT and MT. Those in attendance generally agreed that the S/T level 1 mentioned in the article reflects basically their ideas of the Scope of Practice of an MLT and that the S/T level 2 reflects the entry level MT.

Ms. Ducate discussed the Career Entry Statement of Competence for Clinical Laboratory Sciences (attachment B) that is used by the NCAMLP as their guide to writing criterion-referenced certification exam. The document is in two parts: the first 6 pages are general competences for all areas of the clinical laboratory and the last 3 pages are items that are unique to Microbiology.

The committee discussed the difference between certifying agencies for clinical laboratory practitioners in Microbiology. The CLT of NCA and the MLT of ASCP were equated and the CLS(NCA), MT(ASCP) and RM(AAM)--American Academy of Microbiologists--were discussed in regard to the project. The specialist catagories were considered not relevant to the project and the ISCLT and ASM certifying agencies were considered to be similar and equal to the ASCP and NCA.

Taxonomy levels

The committee then turned its attention to the CMLP Newsletter (Attachment D) that discusses the ASCP Microbiology portion of the ASCP exams. The mechanism used to design and write the certifying exams at the CLA, MLT and MT levels was discussed, and the committee was asked to read through the handouts on their own. The 5 taxonomic levels used by ASCP were briefly defined, however the committee consensus for the project was to use the three modified taxonomic levels (modified version of Bloom's taxonomy): i.e. recall, interpretation, and problem-solving. Examples of each were given to illustrate what is meant by each.

Criterion-referencing

The difference between criterion-referenced and normed referenced examinations was discussed. Ms. Ducate stated that both the NCA and ASCP use the criterion-referencing method of evaluating their results. Criterion-referencing was then defined.

After the above groundwork for the committee was established. The committee was ready to define various parameters it would use in designing the equivalency-exam.

Percent Distribution of taxonomy levels at the MLT and MT levels

The percent distribution of the test items for the MLT and MT exams was discussed. The 4 proposals discussed by the Hematology committee last year (Minutes, Dec 11,1979)were used as a starting point. It was decided that the percents chosed for the hematology did not reflect the entry level requirements for the Microbiology discipline. Some concerns were: (1) It was generally felt that Micro. required more interpretation on the part of both MLT and MT than Hematology might (ex: in reading media reactions and identification of organisms) (2) What constitutes problem solving for MLT in Microbiology? Discussion concerned itself with the recognition of problems in areas of instrumentation, clinical correlation, quality control, gram stain interpretation, media selection, etc. It was agreed that MLT are indeed called upon to problem solve at the entry level expectation, especially on evening shifts and in underserved areas where they may function at an MT capacity.

With the above discussion in mind, the following % of questions in each taxonomy level was decided and/or compromised at :

	Tax 1	Tax 2	Tax 3
MLT	55%	35%	10%
MT	25%	40%	35%

Specialty Areas and Subcommittee Divisions

It was agreed that Serology application is indeed to be covered in Microbiology, however, procedural and theoretical concepts would be left for an Immunology/Serology Proficiency Exam.

Although Clinical Virology is important, most entry level MLT and MTs are not expected to have a proficiency in this area and thus the topic would be considered under specimen processing and not an a separate or distinct entity.

Other areas listed by the committee were: Epidemiology, Parasitology, Mycology, Mycobacteriology, Bacteriology (aerobic and anaerobic), media, sterilization, safety, susceptibility testing, quality control, automation, specimen handling, collecting and processing, new organisms and concepts.

The committee agreed to 4 specialty areas that would constitute the 4 subcommittees with each subcommittee being responsible for 25% of the examination instruments to be developed. They will be : Bacteriology 50%, Mycology/Parasitology 25%, and Miscellaneous (epi, automation, qc, safety, susceptibility, specimen processing) 25%. Bacteriology would be divided into Enterobacteriaceae and Anaerobes for one subcommitee and all other bacteria including mycobacteria in the other subcommittee.

Weights within the Subcommittees

The committee decided to weigh the contents of the various subcommittees since certain areas should constitute more questions. The following is the summary of the consensus:

Group 1	Bacteriology	Enterobacteriaceae 70% Anaerobes 30%
Group 2	Bacteriology	Other bacteria (left to the subcommittee for breakdown)
Group 3	Mycology 40% Parasitology 60%	
Group 4	Miscellaneous	Specimen Processing/Handling & Susceptibility 70% Other 30%

Number of Questions

The Hematology exams aimed at a 2 hour duration with approximately 100-125 questions each. The Micro committee would like to aim at a 200 question exam which would mean 50 questions from each subcommittee for each exam (MLT and MT) plus an addition 50 questions each for forms A and B totalling 200 questions per subcommittee.

Subcommittee divisions and assignments

Ms. Ducate stated that ideally a blend of the 3 types of professionals on the committee should be on each subcommittee, i.e. an MLT educator, MT educator and a Microbiology practitioner. In addition is would facilitate the groups to be geographically grouped. A sign up sheet was passed with the majority of participants open to the best blend that could be achieved by Ms. Ducate.

Travel vouchers

Travel vouchers were distributed with an explanation sheet (Attachment E). The committee members were asked to keep the sheets current and to submit for reimbursement at one time only (in mid to early June) as per the instructions.

Minisession

The next meeting will be set up as a mini-session to discuss the construction of examination question, criterion-referencing by assigning the MPIs as well as content area construction based on the competencies and objectives to achieve the competencies. The committee will be notified within the week as to where and when.

The meeting was adjourned at 5:30 pm.

Respectfully submitted,

Madeline

Susan Mikorski and Madeline Ducate

A

OBJECTIVES of PROJECT

Development and evaluation of proficiency/equivalency exams as mechanisms for advanced placement in the clinical component of a Baccalaureate Degree Program in Medical Technology.

Specific objectives relating to the above

A.1. Evaluate and modify job entry level competencies for clinical laboratory personnel utilizing the expertise of practitioners and educators to this field.

2. Categorize competencies and objectives into basic (MLT) and advanced (MT) components.

B.1. Compile test items for the basic and advanced level which reflect appropriate content and taxonomic level to evaluate student achievement of the objectives described for each subject area.

2. Evaluate construction and design of test questions and make revisions where appropriate.

3. Norm tests through administration to MLT and MT graduates.

4. Revise the initial tests on the basis of item analysis so that renorming could be conducted by the state's professional society in the clinical laboratory sciences.

C. Disseminate information about the examination throughout the state in order to attract the target population.

Rev. 3/81

Time Schedule

ADMINISTRATIVE

Activity	Person	1981 Mar	Apr	May	Jun	Jul
Objectives A, B and C						
Employs coordinator, consultant and secretary	Project Director	X				
Evaluate planned project activities & timetable	Coordinator & Director	X				
Makes arrangements for meetings & travel, typing, xeroxing, etc.	Secretary	X----	----	----	----	X
Organize committee & subcommitees	Coordinator	X				
Dissemiates report	Coordinator					X

PROJECT ACTIVITES

Activity	Person	Mar	Apr	May	Jun	Jul
Objective A						
Compile MLT & MT statements of competencies & objectives	Coordinator	X				
Evaluates & modifies competencies	Committee & Coordinator	X----	X			
Evaluates & modifies educational objectives	Committee & Coordinator		X			
Categorizes competencies & objectives into Basic & Advanced	Subcommittees		X----	X		
Objective B						
Determine % of questions in terms of content & taxonomic levels on Basic & Advanced	Committee & Coordinator	X				
Compile test questions	Coordinator	X				
Prepare questions for Basic & Advanced level exams	Subcommittees		X----	----	X	
Evaluate construction & design of test questions	Committee & Coordinator				X	
Determine Minimum pass level	Committee & Coordinator				X	
Prepare final report (two sets of MLT and MT tests)	Coordinator					X
Objective C						
Preparations for renorming the Hematology Proficiency Exams	Coordinator	X----	X			
Renorming Hematology Exams	MLT & MT Educational Programs				X	
Evaluate scores & final report	Consultant & Coordinator				X	

Competence Delineation

Roma E. Brown
(Chairman, Committee of Competence Delineation)
Chairman
Department of Medical Technology
School of Allied Medical Professions
University of Pennsylvania
Philadelphia, Pennsylvania 19104.

"No group can achieve professional standing without explicit statements about what constitutes competence in that field and the means by which competence can be obtained and assessed." (McCleary)[1]

The pivotal point in this principle is the requirement for a conceptual definition and delineation of competence in a profession. Competence is a holistic characteristic (similar to intelligence) which relates to a position or role. Competence is an integration and application of specific components in a performance role. Concomitantly, the specific components are an integration of interrelated elements of competence.

The concept of competence can be illustrated as a pyramid of hierarchical levels of interrelated elements as shown in Figure 1.

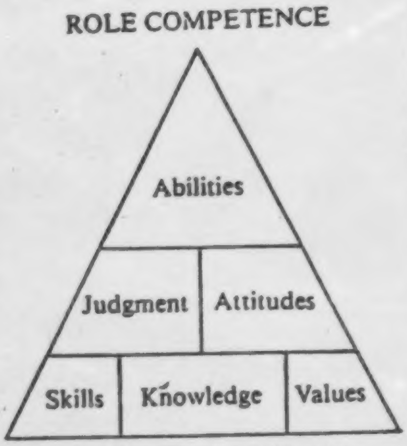

Figure 1: Elements intergrated in role competence.

As visualized, role competence results from an integration of a profile of abilities (the apex of the pyramid), which are the culmination of the integration of judgment and attitudes that are based on skills, knowledge, and values essential to the abilities.

Competence is possession of critically required abilities, knowledge, judgment, skills, attitudes, and values required to fulfill a professional role. Competence assurance is a system aimed at ensuring that practitioners possess the competence necessary to perform in their respective roles.

COMPETENCE DELINEATION

Competence is a fundamental factor in determining: 1) educational goals in professional programs, 2) criteria for certification to enter the profession, 3) strategies for evaluating continued competence of practitioners, and 4) the development of expanded or new roles, or both, for practitioners. Characteristically, professional organizations take the leadership role in planning and implementing, or assuring, the development of programs and activities to address these parameters of a profession. The interacting aspects of these activities require a cohesive plan for effective—and indeed noncontradicting—action. Such a plan is schematically shown in Figure 2. In this matrix, the delineation of what constitutes the performance (i.e. professional practice) of medical technology serves as a central core and data

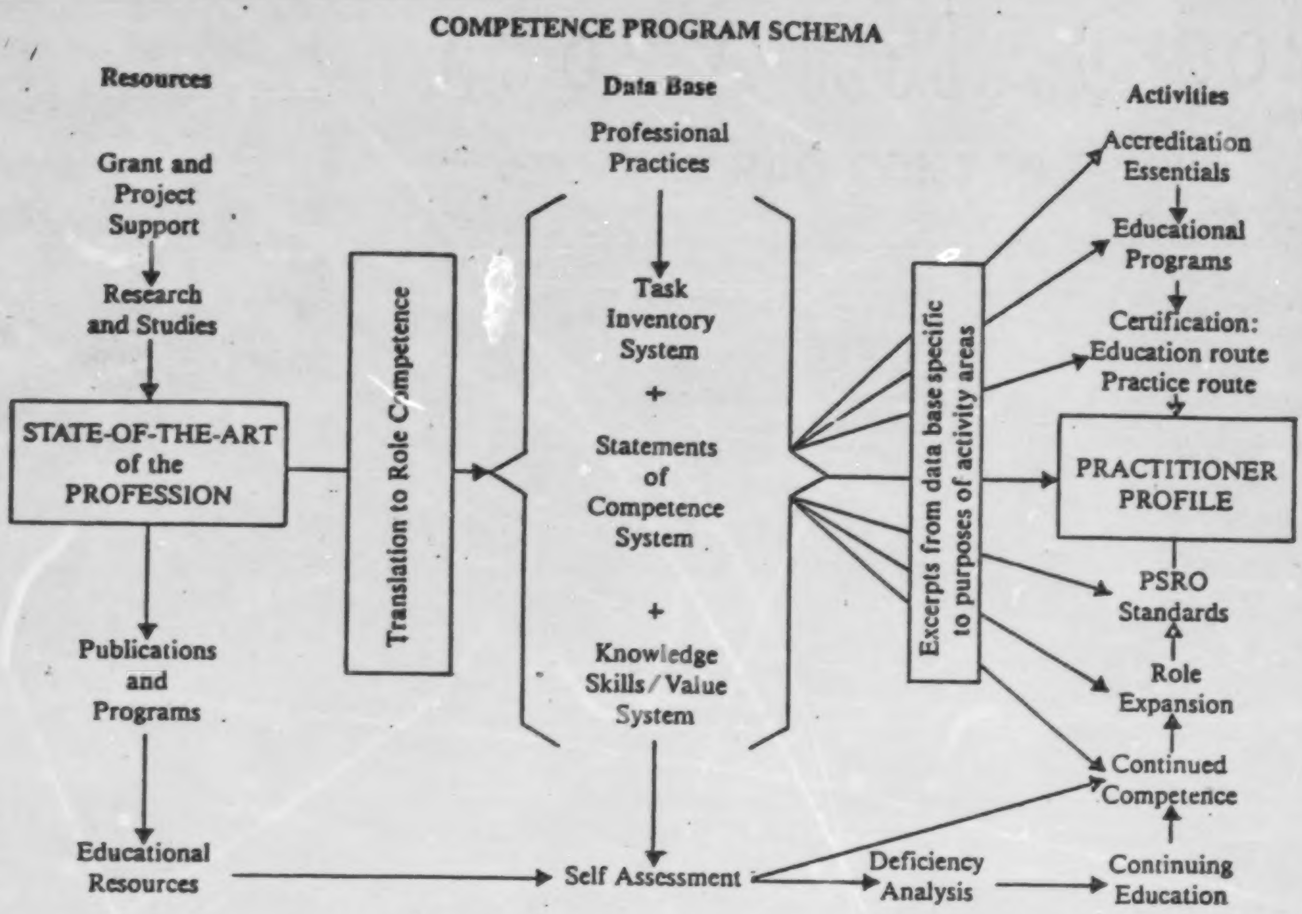
COMPETENCE PROGRAM SCHEMA
Resources
Data Base
Activities
Grant and Project Support
Research and Studies
STATE-OF-THE-ART of the PROFESSION
Publications and Programs
Educational Resources
Translation to Role Competence
Professional Practices
Task Inventory System
+
Statements of Competence System
+
Knowledge Skills / Value System
Self Assessment
Excerpts from data base specific to purposes of activity areas
Accreditation Essentials
Educational Programs
Certification: Education route Practice route
PRACTITIONER PROFILE
PSRO Standards
Role Expansion
Continued Competence
Continuing Education
Deficiency Analysis

Figure 2

base. This provides a means to organize and facilitate access to the resources available to the profession and to optimize the development of interacting activities of the profession. The program is designed to accommodate the changes and advances in the state-of-the-art of the profession and to provide a strategy for their effective incorporation into the activity areas and the role of the professional (practitioner profile).

The ASMT Competence Delineation Committee was appointed in 1974 to develop a systematic approach to the identification of the components of competence in the profession of medical technology, i.e. to develop the data base in the center of the matrix. The scope of professional practice of medical technology was defined as all components of clinical laboratory practice, except those that are *uniquely* within the purview of the physician.

A primary consideration was to recognize and accommodate new or expanded roles in the profession rather than to accept traditional patterns of practice. The resulting components of competence, therefore, include ones that are appropriate for nonphysician practitioners and are performed by them in some settings, although they may not be performed by most such practitioners in all environments. The practitioner role of each individual would be reflected by those components of practice of the profession that are relevant to one's job at a given time in one's professional career. Thus, over time, as an individual changes his/her professional role, the delineation of what constitutes competence will also change, and will be reflected by a different excerpt from the components of competence of the profession.

Three categories were designed for classifying data—Task Inventory, Statements of Competence, and Knowledge/Skills/Values. These categories provide a means for organizing the data in distinct ways, which can be used as independent types of data as well as integrated data, drawing on discrete data from each category integrated to describe a specific component of competence. Comprehensive integration of data from the three categories (through a cross-coding system) would therefore fully describe the competence of the profession. The content of these categories and operational definitions of terms developed by the Competence Delineation Committee are provided in Figure 3.

Small groups of laboratory practitioners in each of the clinical disciplines of medical technology (hematology, immunology, immunohematology, microbiology, clini-

COMPETENCE SCHEMA†

Task Inventory	Statements of Competence	Knowledge/Skills/Values
Clinical Disciplines—Tests Clinical Chemistry Hematology Immunology Immunohematology Microbiology Nuclear Medicine Administrative and Management —Functions and Service Task Conditions Size of lab Nature of supervision Organizational characteristics	*Administrative and Management Comp. *General Laboratory Comp. Discipline—Specific Comp. *These competencies are to be integrated with discipline-specific Competency to reflect total range of competencies for each discipline	Knowledge Domains: Basic sciences Clinical sciences Behavioral sciences General studies Skill Domains: Techniques Conceptual Instrumental Interpersonal Value Domains: Patient oriented Colleague oriented Institution oriented Science oriented

Through cross-reference coding, laboratory practitioner performance can be comprehensively described and appropriately classified to level of practitioner.

Operational Definitions

Terms are used with varying meanings; therefore the following *operational definitions* have been established to facilitate communication and ensure consistency in interpretations.

1. Laboratory Test—a laboratory procedure which results in an output of data (a product) used in health care (both patient data and nonpatient data).
2. Laboratory Functions—an activity essential to create and/or assure the quality of the data but not inherent in its production.
3. Task Inventory—a comprehensive listing of laboratory tests and functions which are (or should be) performed by nonphysician personnel in a service laboratory (all types).
4. Sub-Tasks—inherent parts of a laboratory test or function that may be done by one person and the total task completed by another person without endangering continuity and quality, i.e. a discrete part of the task.
5. A Statement of Competence—a statement of an ability essential to the provision of laboratory services in health care. Each ability implies an intellectual and/or technical skill and/or value and attitude of an individual.
6. Laboratory Service—laboratory data (the product) correlated, validated, and otherwise integrated into patient care or health services.
7. Knowledge Classification System—a system which includes multiple levels of subclassification of the knowledge domains relevant to laboratory tests, functions, and services.

† Reprinted with modifications from Competence Delineation Committee report to ASMT House of Delegates, June 1976.

Figure 3

cal chemistry—general, clinical chemistry—endocrinology/toxicology, nuclear medicine technology, histology, and cytology) were formed into Task Groups. The Task Groups developed a Task Inventory based on professional practices for their respective areas of the clinical laboratory. Using this inventory as a point of reference, each Task Group developed Statements of Competence (abilities) that one must possess to be able to perform these tests. A Task Group of laboratory supervisors prepared statements related to administration and management in a clinical laboratory. The development of the Knowledge/Skills/Values category and the cross-coding among the categories to fully describe the competence of the profession is in progress. It is important to emphasize that information in these categories is continually subject to additions and deletions as the state-of-the-art of the profession changes.

TASK INVENTORY CATEGORY

The Task Inventory Category includes 1) all laboratory tests currently performed in a service laboratory and 2) all laboratory functions performed related to tests or maintenance of systems/conditions related to test performance according to the definition of the Task Inventory in

Figure 3. Because the same output of data can be reached by multiple methodological approaches, certain portions of the Task Inventory are two dimensional to accommodate this variability among laboratories, i.e. one dimension of the Inventory—the output of data, the other—the instrumental or procedural principle. A number of task inventories in the clinical laboratory have been developed, including lists of tests or functions; however, none of these included the scope or conformed to the criteria established for the Task Inventory described in this article.[2,4,5]

STATEMENTS OF COMPETENCE CATEGORY

The Statements of Competence Category includes a series of statements of abilities which imply (but do not include) the specific knowledge, skills, and test specificity and, when correlated with these elements of the other categories, describe what one must possess to function appropriately in the field.

General competence statements applicable to most areas in medical technology and management competence statements were organized into sections which, together with discipline-specific competence statements, comprise the requisite abilities to perform, control, and manage services in each discipline area of the laboratory.

The centrality of the Statements of Competence Category, not only to the work of the Competence Delineation Committee, but also to its application to other activities in the Competence Program shown in Figure 2, influenced the Committee to strive for statements of a generic orientation that could be expanded and elaborated for specific purposes. Specificity of the statements for special uses as noted in Figure 2 is projected as the Statements are used in the activity areas. Because each specific statement will have been based on a generic one, a means for correlation will be maintained.

KNOWLEDGE/SKILLS/VALUES CATEGORY

The elements in this category, when acquired and integrated with judgments and attitudes into abilities, lead to role competence. Types of elements that are planned for this category are shown in Figure 3. The elements in the skill domains include basic technical skills such as basic pipetting as well as complex conceptual skills such as synthesis of analytical data. The cross-coding of the skills category with the Statements of Competence and Task Inventory will illustrate the generalization and transferability of skills across the areas of performance in the clinical laboratory. The Value Domains indicate the types of values which are critical to the delivery of efficient, high quality, and humane laboratory services.

The Knowledge Domains range from those areas of general study that contribute to the development of the "individual as a total person" to the clinical sciences which form the body of knowledge of the profession itself. The clinical sciences—though closely related to the basic sciences—have their own characteristics, their own developmental background, and their own potential for scientific advances that need to be continually explored to advance the application of the clinical sciences in patient care. Continuing the advancement of knowledge in the clinical sciences requires incorporation of scientific developments emanating from the basic sciences as well as studying those phenomena that emanate directly from the clinical sciences themselves or their application in the laboratory. Whereas McClearly stated that defining what constitutes competence in the field is essential to achieving professional standing, a body of knowledge with a primary identification to a field is also an essential criterion for a profession. A further characteristic of a profession is the assumption of responsibility for continuing investigation and research to expand the knowledge and the state-of-the-art of the profession.

THE PROFESSIONALS AND THEIR LABORATORY PRACTICE

This paper has described the relevance of the delineation of competence of a profession to activities aimed at assuring the quality of service provided by the profession. More important than the relevance to the organization and its programs, such delineation is relevant to the individual practitioner—one's role, one's performance, and one's competence. The programs and activities of the organization should assist individuals in self-evaluation of their competence, their role, and their aspirations for advancement. When the elements of competence can be related to current and new roles, they can be used as markers on a "road map" of one's endeavors toward advancing his/her career.

References

1. ASMT Competence Delineation Committee: Statements of Competence of Clinical Laboratory Personnel. ASMT News, August, 1976, p 4-7.
2. Forecast of Skill and Competence Requirements for the Medical Laboratory. Report on Phase I of a Task Analysis Project, National Committee for Careers in the Medical Laboratory, Bethesda, Maryland, 1972.
3. McCleary, L E: Competency based education: What is it and what does it mean for professional preparation? Paper read at the NCPEA Convention, Bellingham, Washington, 1973.
4. Preliminary Report of the Kettering Project to the ASMT Performance Evaluation Committee. Kettering Medical Center, 1974.
5. Task Inventories. Report of the UCLA Allied Health Professions Projects, University of California, Los Angeles, 1971.

CAREER ENTRY

STATEMENTS OF COMPETENCE

CLINICAL LABORATORY SCIENCES

The competence statements which follow are based on the "Statements of Competence of Clinical Laboratory Practitioners (non-physician)" endorsed by the 1976 ASMT House of Delegates, and subsequently published in August, 1976 ASMT NEWS; however they have been refined to represent those competences considered to be appropriate for career entry for clinical laboratory scientists and clinical laboratory technicians.

It should be noted that competences for career entry practice include knowledge, skills and attitudes and that levels of proficiency may vary from full development to simple awareness on the part of the new graduate.

A glossary of terms used is included.

February 1978

Reprinted with Permission, November, 1979, National Certification Agency for Medical Laboratory Personel.

The designation "CLS" to the left of a competence statement indicates the clinica
laboratory scientist level only. The absence of a designation indicates that the statement is appropriate for both the clinical laboratory scientist and clinical laboratory technician.

STATEMENTS OF COMPETENCE

CLINICAL LABORATORY
(General)

A. REQUEST FOR LABORATORY PERFORMANCE/PROCEDURE

1. Implement systems and procedures for receiving, controlling, and verifying laboratory performance requested by an appropriate source.

   a. Maintain an accession system
   b. Monitor progress of requests for work
   c. Verify completion and reporting of results

(CLS) MT 2. Assess and/or respond to clinical considerations to rank the order of performance of procedures, e.g. patient morbidity, diagnosis and/or treatment.

(CLS) MT 3. Obtain patient information by review of medical record as pertinent to test performance and/or evaluation of results, e.g. drugs administere
radionuclide administration, pregnancy status.

4. Implement an efficient response mechanism to optimize laboratory productivity.

(CLS) MT 5. Evaluate the systems and procedures for receiving, controlling and verifying laboratory performance for optimum efficiency.

B. SPECIMEN COLLECTION

1. Implement existent policies for patient and specimen identification and control procedures fulfilling internal and external policies and regulations including medico-legal responsibilities.

2. Evaluate requested procedure to determine appropriate specimen collectio
parameters, e.g. time of collection, status of patient, handling of spe
men, medico-legal requirements.

3. Evaluate patient status in relation to collection procedures, e.g. appr
hension, physical responsiveness, clinical conditions.

4. Communicate appropriately with the patient considering age, stress, medi
cation and isolation, and comprehension of patient and established poli
e.g. instructions, information, assurances.

5. Select and prepare appropriate site for specimen collection considering
conditions that have an effect on the specimen, e.g. collection techni
antiseptic used.

6. Select appropriate collection apparatus, e.g. equipment, container, pre
vative, anticoagulant.

(CLS)MT 7. Instruct personnel collecting specimens as required.

8. Obtain specimen using appropriate technique and maintain integrity of specimen in relation to test to be performed.

   a. Collection technique, e.g. capillary, arterial or venipuncture; swab, aspiration or scraping.
   b. Collection conditions, e.g. aerobic/anaerobic, aseptic isolation.
   c. Specimen considerations, e.g. deterioration of constituents over time; temperature and light restrictions.

9. Assist with collection of other specimens when appropriate, e.g. bone marrow, other tissue, spinal fluids.

10. Assess patient's reactions to collection procedures, e.g. fainting, stress symptoms, excessive trauma consequences; administer aid and/or obtain assistance and complete necessary medico-legal forms.

C. SPECIMEN PREPARATION

1. Implement, and monitor specimen accession, identification, and retention systems meeting internal and external policies and regulations.

   a. Ensure the nature of the specimen, e.g. fresh; preserved.
   b. Determine the requirements of the assay, e.g. amount, type.
   c. Communicate discrepancies, if any, to appropriate persons.
   d. Recognize and properly identify biohazardous specimens.

2. Inspect and evaluate suitability of the specimen for the analysis requeste

   a. Assess specimen characteristics, e.g. fasting, time of collection, drugs: presence, time of dose, expected effect, i.e. crossreaction, stimulation/depression, interference.
   b. Assess acceptibility of specimen, e.g. hemolysis, time of collection, anticoagulant, preservative, storage conditions.
   c. Assess requirements for analysis, e.g. plasticware vs. glassware, siliconed vs. non-siliconed, aerobic vs. anaerobic, room temperature vs. refrigeration, light vs. dark including time interval between collection and initiation of analysis.
   d. Assess conformance to requirements for special purposes of analysis, e.g. forensic testing, paternal studies.

3. Prepare aliquot(s) or component(s) of specimen for analysis according to specifications related to the type of specimen or analysis to be performed

   a. Mix or separate particulate portion and liquid portion of specimen by appropriate technique, e.g. stir, shake, centrifuge, filter, extract
   b. Measure total specimen and/or fraction/sample removed for analysis using quantitative devices, e.g. volumetric measures, gravimetric, micro and ultra-micro techniques, sampling instruments.
   c. Manipulate or modify sample to meet the specifications of the analysis or to isolate the component(s) necessary for the test procedure, e.g. extract specimen from other particulate matter, innoculate or inject into media or instruments to obtain material for analysis.

        d. Conform to an appropriate specimen retention system which maintains the integrity of the specimen, e.g. requirements of the component, requirements of the assay.

    4. Prepare smears, imprints, droplets or mounts of the specimen for analysis according to specifications related to the type of specimen or the analysi to be performed.

        a. Select portion of specimen to prepare sample for observation/testing according to criteria relevant to the analysis.
        b. Utilize techniques that maintain integrity of specimen and/or optimize observation or analysis.

    5. Utilize referral services as appropriate to limitations of laboratory resources and/or priorities.

        a. Determine conditions essential to maintain integrity of specimen during transport.
        b. Prepare for proper transport of specimen.

D. REAGENT PREPARATION AND CONTROL

    1. Evaluate and select chemicals and biologicals including radionuclides conforming to purity, specificity, potency, lack of pyrogenicity, sterility, and stability required for the analysis.

(CLS)MT a. Select manufacturer based on product specifications.
        b. Evaluate product received in relation to assay specifications
LS)MT c. Determine appropriate substitues for unavailable supplies.

    2. Select appropriate measuring devices, e.g. balances, glassware and storage containers for reagents.

    3. Compute the amount of each constituent required to prepare the desired solution. e.g. pH, concentration.

    4. Prepare reagents according to prescribed directions, observing constraints of reactivity, e.g. temperature, pH, solubility requirements, precision and accuracy, safety, e.g. hood, goggles.

    5. Assess the adequacy of the reagent.

        a. Assay in parallel with currently accepted reagent.
        b. Perform criterion assay, e.g. titration, pH, incubation overnight.

    6. Maintain a reagent log and control system.

        a. Record significant data on purchased chemicals, biologicals, radionuclides, e.g. source, lot numbers, date of receipt.
        b. Label prepared reagents, e.g. name, content, concentration, date received/opened, expiration date, safety precautions.
        c. Store and dispose of reagents properly, e.g. in relation to stability and safety requirements.
            1) Stock reagents, e.g. lyophilized, frozen radioactive, corrosive, flammable, infectious.
            2) Working reagents, e.g. diluent effects

E. INSTRUMENTATION AND EQUIPMENT

1. Calibrate and/or standardize instruments using appropriate materials by applying criteria for acceptable calibrations.
    - a. Simple, e.g. basic spectrophotometer or autoanalyzer.
    - (CLS)MT b. Complex, e.g. recording spectrophotometer; multichannel analyzer.
2. Operate instruments utilizing established protocols and quality control checks, e.g. mechanical, optical, scintillation, gasometric, photometric, electrometric, automated.
3. Maintain instruments and equipment according to established protocol, e.g. adjust, clean, replace.
4. Apply appropriate criteria to evaluate instrument performance and recognize malfunction.
5. (CLS)MT Trouble-shoot instrument malfunction utilizing schematics, design/function of component parts, and trouble-shooting check lists.
    - a. Repair instrument malfunction, e.g. simple instruments and repairs.
    - b. Indentify need for external services.

F. MAINTENANCE AND SAFETY

1. Utilize a preventive maintenance program for all instruments and equipment and a recording system to include:
    - a. Type and frequency of checks necessary for each item.
    - b. Criteria for checks which indicate special maintenance action.
    - c. Type and frequency of routine maintenance activity for each item.
    - d. A log system to record routine and special maintenance actions.
    - e. Implementation of a protocol.
2. Provide for in-house repair or outside service as indicated.
    - (CLS)MT a. Compare repair with replacement, e.g. cost, feasibility, maintenance.
    - b. Maintain supply of parts.
    - c. Perform appropriate in-house repairs.
    - (CLS)MT d. Select service company for external services.
3. (CLS)MT Establish a plan for cleaning glassware, plasticware, and instruments, and for instruction of personnel.
    - a. Develop protocol.
    - b. Monitor conformity to protocol.
    - c. Monitor quality of product.
4. (CLS) MT Establish a plan for storage and disposal of samples, reagents, and supplies based on characteristics of the material to be disposed, e.g. volatile, inflammable, infectious, corrosive.
    - a. Develop protocol.
    - b. Monitor conformity to protocol.

5. Implement safety measures to detect and minimize hazards, e.g. infectiou materials, chemicals, compressed gasses, electrical appliances, toxic fumes, carcinogens, radioactive contamination, fire and mechanical injur which meet internal and external regulations, e.g. OSHA, NRC.

    a. Ensure that equipment meets safety regulations.
    b. Instruct personnel in safety measures, e.g. fire drills, first aid, bio and chemical hazards.
        1) Identify sources of biohazards, develop protective procedures.
        2) Monitor all packages containing radionuclides as required by regulations.
        3) Recognize and ensure correction of unsafe laboratory practices.
    c. Take immediate action to be taken in case of personnel accident or injury.
        1) Recognize the need for medical aid.
        2) Assist the injured person.
        3) Secure medical aid.
    d. Identify and remove sources of contamination.
        1) Clean areas/materials appropriately based on type/character.
        2) Modify safety plan as indicated.
    e. Monitor conformity to safety standards.

G. QUALITY ASSURANCE

(CLS)MT 1. Maintain a quality assurance program.

    a. Indentify parameters and determine acceptable range for each paramet
    b. Analyze data and interpret results.

2. Conform to established quality control procedures.

3. Select and prepare control samples appropriate to monitor assays/procedu

    a. Utilize protocol for evaluating control sample value, e.g. within-da variation, day-to-day variation, trends, shifts.
    b. Determine action to be taken when control sample is outside acceptab limits.
    c. Take appropriate action when control sample is outside acceptable li

4. Perform quality control procedures on equipment, reagents and products w appropriate check systems.

(CLS) MT 5. Evaluate results of quality control procedures and implement corrective actions when indicated.

6. Maintain record keeping systems, e.g. specimen accession and retention, instrument maintenance, quality control samples.

7. Participate in a proficiency testing program.

H. GENERAL THEORETICAL PRINCIPLES

1. Know chemical and physical principles utilized in test performance.

a. Know mechanisms of routine tests, e.g. high frequency of performance.

(CLS) MT b. Know general principles of non-routine tests, e.g. low frequency of performance.

2. Know principles of physiology.

   a. Recognize factors that influence test results.
   b. Understand relationships among various body systems.

(CLS) MT 3. Know principles of basic pathology.

   a. Recognize general pathological concepts.
   b. Know processes of systemic disorders diagnosed, treated and prevented primarily through laboratory findings.

I. TESTS/PROCEDURES

1. Assess appropriateness of results.

(CLS) MT 2. Assess results in terms of other laboratory data and/or clinical information.

J. INTERPERSONAL RELATIONS

1. Demonstrate appropriate communications skills for transmitting ideas or information to others and reporting results.

2. Participate in good public relations for the laboratory, e.g. information for visitors, relegate patient concerns to appropriate person, participate in community activities.

STATEMENTS OF COMPETENCE
Microbiology

A. SIGNIFICANT PARAMETERS OF ANALYSIS

(CLS) MT 1. Establish and maintain appropriate identification schema for the various classifications of organisms.

a. Utilize appropriate identification schema for the various classifications of organisms:

1) Determine growth characteristics/requirements.
2) Select media and confirmatory tests/procedures.

2. Compare methods for growth and identification of microbial organisms.

a. Select approprate media and biochemical techniques e.g. enrichment, selective, and differential.
b. Utilize new information on cultural/growth characteristics of organisms in the identification of schema.
(CLS)MT c. Assess new identification methods, e.g. stains, typing, biochemicals that enhance differentiation.
d. Record, review and report results.

3. Utilize new technical approaches and instrumentation which improve quantitative capability, specificity, or accuracy in identification of organisims.

(CLS) MT 4. Utilize the principles of host-parasite relationships, pathogenesis of infectious diseases, and epidemiology of infections diseases in the establishment of protocols for investigating and reporting findings on microbial organisms and therapeutic indications, e.g. pathogenic vs. normal flora.

5. Utililze proper safety procedures for the handling of infectious materials, e.g. laminar flow hood, disinfectants.

B. TEST PERFORMANCE AND RESULTS

1. Prepare direct smears.

a. Select methods based on specimen source or suspected organism, e.g. direct smear, wet preparations.
b. Process the specimens appropriate for cultural methods, e.g. concentrate, digest.
c. Prepare wet-preparations, stained or unstained from the optimal portion of the specimen, e.g. spinal fluid, parasite preparations.
d. Prepare fixed-smear preparations from optimal portion of specimen, e.g. sputum, direct swabs, scrapings.

2. Perform and evaluate direct smears or other types of direct preparations, e.g. touch preparations.

a. Assess morphological and structural characteristics of organism(s) and other specimen contents, e.g. cells, fibers.

    b. Describe microscopic observations, e.g. staining characteristics, morphology.
    c. Correlate observations with the principle of the staining procedure to make conclusion, e.g. gram, capsule, acid-fast, spores.

3. Implement a culture/identification protocol appropriate to the source and characteristics of the specimen and the conclusions of direct-smear evaluations.

(CLS)MT
    a. Determine the appropriate culture/identification protocol.
    b. Prepare the specimen appropriately for the cluture or identification portocol, e.g. digestion.
    c. Perform inoculations appropriate to the media prescribed in the protocol, e.g. streak, stab, quantitative loops.
    d. Prepare slide culture preparations.
    e. Provide appropriate growth conditions according to the requirements of the organism, e.g. anaerobic, aerobic, CO_2.

4. Evaluate the sequential steps in an identification schema:

    a. Distinguish growth characteristics of organisms, e.g. hemolysis, colony morphology, temperature, oxygen requirements.
    b. Prepare and evaluate routine and special stained smears from colony growth:

        1) Select colonies to be examined.
        2) Utilize appropriate type of microscopy.
        3) Correlate observations on the smear with the principle of the stain procedure.

    c. Select biochemical tests based on colony morphology, differential growth factors, characteristics and smear evaluations.
    d. Perform biochemical test using the inoculation technique appropriate to the biochemical media.
    e. Evaluate the biochemical test results, e.g. observe and assess color, zones, gas formation, liquid/solid formations based upon the criteria defined for the test.
    f. Assess biochemical profiles and correlate with colony characteristics and smear evaluations.

5. Select and perform serological tests, e.g. confirmatory tests for cultur identification, type differentiations.

    a. Assess direct slide agglutinations.
    b. Pipette or titrate tube dilution methods.
    c. Prepare and assess microscopic methods e.g. light and fluorescent.

(CLS) MT 6. Integrate analyses and patient/specimen information to determine genus, species, and type of organism(s).

7. Utilize quantitative techniques, e.g. calibrated loops, pipets, in conjuntion with cultural procedures to quantitate microorganisms.

    a. Utilize ~~direct~~ counting instruments.
    b. Calculate concentrations in specimens.

8. Select and perform appropriate antimicrobial evaluation procedures and assess antimicrobial susceptibility of organism(s).

    a. Utilize conventional antimicrobial procedures adhering to the specifications of antimicrobial testing.
    b. Assess and/or measure -cidal/ - static effects, e.g. growth, suppression, zones of inhibition.
CLS) MT c. Interpret -cidal/ -static effects.
CLS) MT d. Evaluate patient information and serum antibiotic agar assay.
    e. Utilize antimicrobials appropriate to organism and source.

9. Report results through appropriate systems conforming to established procedures and recognize parameters which indicate immediate notification.

C. INFECTION CONTROL AND THERAPEUTIC PROCEDURES

LS) MT 1. Monitor infection patterns in the health care setting.
LS) MT 2. Select sites and collect samples for microbiological testing from high risk areas, e.g. nursery, operating rooms, and monitor results to determine correlations.

LS) MT 3. Recognize and report deviations in expeted susceptibilities.

4. Report communicable diseases to the health department according to established policies and procedures.

A-MT
ASMT 46' 5C
Nov. 1980

House Adopts Position Papers

Diana Mass
Chairman
Competence Assurance Council

Rapid developments in the clinical laboratory sciences profession have resulted in extensive changes in the services provided by clinical laboratory personnel. The breadth of practice and the depth of knowledge now required to provide these services are reflected in the scope and levels of practice evident in today's clinical laboratory. To ensure that these services are of high quality, ASMT has assumed the responsibility of providing laboratory personnel with opportunities to keep abreast of expanding technologies and to maintain their competence to perform their designated tasks. This responsibility is awesome, and ASMT is determined to approach this sophisticated challenge in a systematic manner as the Competence Assurance System evolves.

Two papers, adopted by the ASMT House of Delegates in June, are *The Scope of Practice of the Clinical Laboratory Sciences* and the *Levels of Practice of the Clinical Laboratory Sciences. The Scope of Practice* identifies, in general terms, services provided in clinical laboratory sciences. The *Levels of Practice* identifies and describes performance roles at several levels of responsibility which ought to exist in the clinical laboratory. Both papers are published here in their entirety.

To be effective, the Competence Assurance System must contain educational and assessment mechanisms which are determined by explicitly defined levels of practice. By defining roles in terms of specific knowledge, skills, and attitudes required for acceptable performance, the levels of practice become the reference points of the Competence Assurance System. These levels of practice will be monitored and updated continually to reflect the changing and expanding roles within the parameters of the profession.

SCOPE OF PRACTICE

Clinical Laboratory Professionals, as members of the health care team, are responsible for:

1. Assuring reliable test results which contribute to the prevention, diagnosis, prognosis and treatment of physiological and pathological concerns. This includes:
   a. Producing accurate test results
   b. Assessing and improving existing laboratory methodologies
   c. Designing, evaluating and implementing new methodologies
   d. Integrating, correlating and interpreting test data
2. Designing and implementing cost-effective administrative and quality control procedures for laboratories, services and personnel.
3. Designing, evaluating and implementing new methodologies
4. Developing and monitoring a Quality Assurance System to include:
   a. Quality Control of Services

able to suggest a logical protocol for the physician to follow in confirming the diagnosis of a patient.

Supervisory/Administrative Service

S/A Level I personnel should be able to:

- perform all functions within Level III of the Scientific/Technical Service as a Generalist or Specialist;
- participate in the establishment of a system that ensures the reliability of tests performed in accordance with established standards;
- implement and monitor such systems;
- assist in the preparation of and monitor staffing schedules to provide coverage and effective utilization of personnel;
- supervise and evaluate the performance of personnel and monitor work flow;
- provide technical instructions and training of personnel;
- assist in preparation of budget;
- assist in selection of supplies and equipment and monitor their use;
- develop appropriate documents and manuals to ensure proper performance of tests.

S/A Level II personnel should be able to:

- coordinate all functions of Level I Supervisory/Administrative Service;
- design, establish and evaluate an ongoing personnel selection, orientation and development program to meet the needs and scope of the laboratory services;
- establish and implement a laboratory safety program;
- assist in determination of educational needs of laboratory staff;
- determine, establish and evaluate a financial management plan in accordance with policies and procedures of the institution;
- develop and implement a system for productivity evaluation, work measurement and daily staffing needs;
- establish and maintain an appropriate public relations image for the laboratory;
- develop goals and objectives for the clinical laboratory;
- develop and implement operating policies and procedures in accordance with institutional policies and rules of all regulatory agencies;
- justify fiscal needs internally to institution and externally to state review committees;
- develop and implement a system of peer review of laboratory services;
- represent laboratory in interactions with other departments and members of health care team.

Educational Service

E Level I personnel should be able to:

- perform all functions within Level II of the Scientific/Technical Service as a Generalist or Specialist;
- demonstrate tasks to be performed by the learner;
- contribute to the design, implementation and evaluation of the clinical practice experience.

E Level II personnel should be able to:

- perform all functions of Level I Educational Service within their specialty;
- design, implement and evaluate one or more courses in the clinical laboratory sciences. Implementation includes the presentation of theoretical information through didactic sessions and presentation of practical information through demonstration and laboratory practice;
- evaluate student's theoretical knowledge and practical abilities.

E Level III personnel should be able to:

- perform all functions of Level II Educational Service within their specialty;
- develop and implement program philosophy;
- design, implement and evaluate a generalist, specialist or continuing education program in the clinical laboratory sciences;
- coordinate program goals, objectives and policies with affiliated academic institutions;
- coordinate learning experience within the clinical environment;
- supervise instructing personnel.

E Level IV personnel should be able to:

- perform all functions of Level III Educational Service, but may no longer perform the duties of Level I or II of Educational Service;
- administer program to meet accrediting specifications;
- develop and maintain desirable relationship/affiliation with other programs and institutions;
- monitor job market requirements in order to update curriculum;
- secure and manage the resources (facilities and funding) for the operation of the program.

The Levels of Practice for the Clinical Laboratory Sciences profession are the reference points of the ASMT Competence Assurance System. These levels will determine the educational and professional evaluation mechanisms required to make this System effective and efficient.

The Competence Assurance System will provide laboratory personnel with opportunities for progression. In identifying the Levels of Practice, relationships in a career line can be clearly defined, allowing individuals to move vertically to the highest level of their capabilities and laterally to related fields of endeavor.

As the demand for and the complexity of laboratory services continues to increase, the Levels of Practice with the corresponding competencies will continue to evolve. Using input from all laboratory professionals, as well as other professional organizations, ASMT will continually monitor and update the Levels of Practice to reflect the changing and expanding roles within the scope of the Clinical Laboratory Sciences profession. This dynamic process ensures the quality of laboratory services that are essential to the best interests of public health. □

Attachment D

AMERICAN SOCIETY OF CLINICAL PATHOLOGISTS
2100 WEST HARRISON STREET • CHICAGO, ILLINOIS 60612 • (312) 738-1336

COMMISSION ON MEDICAL LABORATORY PERSONNEL
ROSSER L. MAINWARING, M.D., Commissioner

CMLP NEWSLETTER

Volume II, Number 4

October, 1974

THE MATERIAL BEING PRESENTED FOR INFORMATION TO DIRECTORS AND EDUCATION COORDINATORS WILL NOT BE IMPLEMENTED UNTIL THEY HAVE HAD ADEQUATE TIME TO DIGEST THIS AND THEY WILL BE GIVEN ADEQUATE WRITTEN NOTICE AS TO WHEN THIS WILL BE IMPLEMENTED

EXAMINATION CONTENT GUIDELINES OF THE BOARD OF REGISTRY CERTIFICATION EXAMINATIONS FOR MT, MLT & CLA

In the March-April 1974 Newsletter (Volume II, Number 2) the Board of Registry of ASCP presented a Statement of Purpose for its generalist certification examinations — MT(ASCP), MLT(ASCP) and CLA(ASCP). This current Newsletter is the first of a series which will detail and explain Examination Content Guidelines. These Guidelines will identify the content of the three generalist examinations and the areas of commonalities and differences among them according to the concepts presented in the ASMT position paper, "A Differentiation Among MT, MLT & CLA," reprinted in the March-April Newsletter. The Guidelines are developed with the recognition of the expanded role of the Medical Technologist in problem solving, management, education and research and development.

As stated in the previous Newsletter, it is not the purpose of these Guidelines to define or prescribe the detailed goals and objectives of the educational process. These Examination Content Guidelines will be used by the Board of Registry in constructing and evaluating the certification examinations. The Guidelines are not intended to be an inclusive curriculum guide nor are they intended to be exhaustive listings of all the topics which should be included in the instructional objectives of an educational program.

These Guidelines will be presented in terms of each knowledge area represented on the generalist certification examinations. The knowledge areas are essentially the subtests into which these examinations have historically been divided:

Microbiology (including bacteriology, mycology, parasitology, virology)
Hematology (including coagulation)
Chemistry (including instrumentation)
Immunology (including immunohematology)
Miscellaneous Topics (including urinalysis, other body fluids, laboratory mathematics, cytogenetics, management & supervision, education, and research & development)

Knowledge areas are further divided into content areas: the content areas are subsequently subdivided into topics, subtopics and specific material. An example of this structure as illustrated in the microbiology outline on page 5 is:

Knowledge area:	MICROBIOLOGY
Content area:	I. Cocci — gram positive and negative
Topic:	A. Morphology (cellular)
Subtopic:	3. Structures
Descriptive components:	c. capsule

The Guidelines will be presented in two sections: first, a general outline comprised of content areas, topics, subtopics and descriptive components; secondly, a grid technique which graphically displays the emphasis given each

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(continued on next page)

I. Cocci – gram positive and gram negative	Medical Technologist 35 questions Taxonomy Levels					MLT 35 questions Taxonomy Levels					CLA 35 questions Taxonomy Levels				
	1	2	3	4	6	1	2	3	4	6	1	2	3	4	6
B. [illegible]	0-1	0-1	0-1			0-1	0-1	0-1			0-1	0-1			
1. [illegible]	0-1					0-1	0-1	0-1			0-1	0-1			
2. [illegible]		0-1	0-1			0-1	0-1	0-1							
3. [illegible]	0-1	0-1	0-1			0-1	0-1				0-1	0-1			
4. [illegible]	0-1	0-1				0-1					0-1				
C. Secondary identification		0-1	0-1	0-1	0-1	0-2	0-2	0-2	0-1		0-2	0-1	0-1		
1. [illegible]		0-1	0-1			0-1	0-1	0-1			0-1	0-1	0-1		
2. [illegible]		0-1	0-1	0-1		0-2	0-2	0-2	0-1		0-1	0-1	0-1		
3. Antigenic structure and serological identification			0-1	0-1	0-1	0-2	0-1	0-1	0-1		0-2	0-1	0-1		

The relative importance of each topic within each content area is determined by the number of possible questions indicated, rather than by the order in which the topics are listed.

Utilizing the taxonomy levels and number of possible questions in the cells on a grid also allows a comparison of the expected capabilities of the three categories of generalist laboratory personnel. In the example above, these relationships for "gram positive and gram negative cocci — secondary identification" can be identified in several ways:

1. By comparing the taxonomy levels used for "secondary identification", it is evident that technologists are expected to be able to answer analysis and evaluation questions. MLT's may be asked an analysis question, but CLA's will not be asked questions of either type.

2. Both CLA and MLT exams may contain recall questions on this topic, while the MT exam will not.

3. There is likely to be more total emphasis on "secondary identification" on the MLT exam than either the MT or CLA exams.

4. For the subtopic "antigenic structure and serological identification", a maximum number of three questions may be asked for MT's; a maximum of five questions for MLT's; and a maximum of four questions for CLA's. Thus, "antigenic structures . . ." has proportionally more weight for MLT's than it does for CLA's and MT's.

Numerous other comparisons such as these can be made.

Another dimension necessary, but not shown on the grids, is the appropriateness of the questions used. For example, a medical technologist is expected to recall the role of Renin, while neither an MLT or CLA is expected to demonstrate this knowledge. A CLA is expected to recall normal values, while a medical technologist is expected to interpret abnormal results and correlate them with other findings assuming the necessary recall and understanding of normal values. There are no questions for CLA's nor MLT's in such content areas as "Microbial Genetics," but these questions are appropriate for medical technologists.

Appropriate questions will be developed at all taxonomy levels for all categories of personnel. The higher taxonomy levels will be used more frequently in the medical technology exam; however, appropriate taxonomy 4 and 6 questions will be included in the MLT and CLA exams. For example, in the area of quality control in hematology, the CLA would be expected to demonstrate knowledge of how to record these data on a chart; the MLT would be expected to do this plus make some judgements concerning their validity; and the medical technologist would do all of this plus demonstrate a capability for establishing the quality control procedures and troubleshooting problems that arise in the program.

The concept and content of the general guide and grids have been developed, studied and evaluated by experts in the various fields of medical laboratory technology during the past two years. The content areas of the grids are not intended to be an exhaustive compendium of all the topics pertinent to medical laboratory technology. They represent, in the opinion of these teachers and practitioners, the areas of prime importance for one evaluation of competence at career entry in the various categories of medical laboratory technology.

GENERAL OUTLINE
MICROBIOLOGY KNOWLEDGE AREA

Content Areas I through V have essentially the same general format as appropriate for each Area.

I. Cocci – gram positive and negative
II. Gram positive, aerobic and anaerobic rods
III. Enteric and other gram negative rods
IV. Mycobacteria and miscellaneous organisms (spirochetes, mycoplasma, etc.)
V. Mycology (yeast, molds and yeast-like molds)
    A. Morphology (cellular)
        1. General
            a. shape
            b. arrangement
        2. Use of stains – staining characteristics
        3. Structures
            a. flagella
            b. spores
            c. capsule
            d. granules
    B. Cultural characteristics
        1. Media
            a. growth requirements
            b. inhibitory compounds
            c. role of nutrients in metabolism
        2. Redox potential
        3. Environmental requirements*
        4. Colonial appearance
            a. size, shape, consistency, etc. of colony
            b. chromogenesis
            c. effect on blood
            d. effect on other media
    C. Secondary identification
        1. Physiological characteristics
        2. Biochemical reactions
        3. Antigenic structures and serologic identification
    D. Specimens
        1. Sources
        2. Processing
            a. safety procedures
            b. contaminants
            c. primary culture
    E. Interpretation and/or trouble shooting*
VI. Parasites
    A. Morphology
        1. Shape
        2. Structures
    B. Specimens
        1. Sources
        2. Contaminants and artifacts
    C. Life cycles**

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*No questions for CLA in topic or content area

**No questions for CLA or MLT in topic or content area

I. Cocci – gram positive and gram negative	Medical Technologist 3-5 questions Taxonomy Levels					MLT 3-5 questions Taxonomy Levels					CLA 3-5 questions Taxonomy Levels			
	1	2	3	4	6	1	2	3	4	6	1	2	3	4
A. Morphology (cellular)	0-1					0-1	0-1				0-1	0-1		
1. General	0-1					0-1	0-1				0-1	0-1		
2. Use of stains – staining characteristics	0-1					0-1	0-1				0-1	0-1		
3. Structures	0-1					0-1					0-1			
B. Cultural characteristics	0-1	0-1	0-1			0-1	0-1	0-1			0-1	0-1		
1. Media	0-1					0-1	0-1	0-1			0-1	0-1		
2. Redox potential		0-1	0-1			0-1	0-1	0-1						
3. Environmental requirements	0-1	0-1	0-1			0-1	0-1				0-1	0-1		
4. Colonial appearance	0-1	0-1				0-1					0-1			
C. Secondary identification		0-1	0-1	0-1	0-1	0-2	0-2	0-2	0-1		0-2	0-1	0-1	
1. Physiological characteristics		0-1	0-1			0-2	0-1	0-1			0-1	0-1	0-1	
2. Biochemical reactions		0-1	0-1	0-1		0-2	0-2	0-2	0-1		0-1	0-1	0-1	
3. Antigenic structures and serological identification			0-1	0-1	0-1	0-2	0-1	0-1	0-1		0-2	0-1	0-1	
D. Specimens	0-1					0-1	0-1	0-1			0-1	0-1		
1. Sources	0-1					0-1	0-1	0-1			0-1	0-1		
2. Processing	0-1					0-1	0-1				0-1	0-1		
E. Interpretation and/or trouble shooting		0-1	0-1	0-1	0-1		0-1	0-1						

II. Bacilli – gram positive, aerobic and anaerobic	3-5 questions					3-5 questions					3-5 questions			
A. Morphology (cellular)	0-1					0-1	0-1				0-1	0-1		
1. General	0-1					0-1	0-1				0-1	0-1		
2. Use of stains – staining characteristics	0-1					0-1					0-1	0-1		
3. Structures						0-1					0-1	0-1		
B. Cultural characteristics	0-1	0-1	0-2	0-1		0-1	0-1	0-1			0-1	0-1		
1. Media	0-1					0-1	0-1	0-1			0-1	0-1		
2. Redox potential	0-1	0-1	0-2	0-1		0-1	0-1							
3. Environmental requirements			0-1	0-1		0-1	0-1				0-1	0-1		
4. Colonial appearance	0-1	0-1	0-1	0-1		0-1					0-1	0-1		
C. Secondary identification		0-1	0-1	0-1	0-1	0-3	0-3	0-2	0-1		0-2	0-2	0-1	0-1
1. Physiological characteristics		0-1	0-1	0-1	0-1	0-3	0-3	0-2	0-1		0-2	0-2	0-1	0-1
2. Biochemical reactions		0-1	0-1	0-1		0-2	0-2	0-1	0-1		0-2	0-2	0-1	
3. Antigenic structures and serological identification		0-1	0-1	0-1		0-3	0-2	0-2	0-1		0-2	0-1	0-1	0-1
D. Specimens	0-1	0-1	0-1			0-1	0-1	0-1			0-1	0-1		
1. Sources	0-1					0-1					0-1	0-1		
2. Processing	0-1	0-1	0-1			0-1	0-1	0-1			0-1	0-1		
E. Interpretation and/or trouble shooting			0-2	0-1	0-1		0-1	0-1						

V. Yeasts, molds and yeast-like molds (Mycology)	Medical Technologist					MLT					CLA			
	4-6 questions					4-7 questions					3-5 questions			
	Taxonomy Levels					Taxonomy Levels					Taxonomy Levels			
	1	2	3	4	6	1	2	3	4	6	1	2	3	4
A. Morphology (cellular)	0-1	0-1	0-1	0-1	0-1	0-2	0-2	0-1			0-3	0-3	0-2	
1. General		0-1	0-1	0-1	0-1	0-2	0-2				0-2	0-2	0-1	
2. Use of stains — staining characteristics	0-1	0-1	0-1			0-2	0-1							
3. Structures		0-1	0-1			0-1	0-1	0-1			0-2	0-2	0-2	
B. Cultural characteristics	0-1	0-1	0-2	0-1	0-1	0-3	0-2	0-1			0-1	0-1	0-1	0-1
1. Media			0-2	0-1	0-1	0-2	0-1	0-1			0-1	0-1	0-1	
2. Redox potential			0-1	0-1		0-1	0-1							
3. Environmental requirements		0-1	0-1			0-1	0-1				0-1	0-1	0-1	0-1
4. Colonial appearance	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1			0-1	0-1	0-1	0-1
C. Secondary identification		0-1	0-1	0-1	0-1	0-1	0-1	0-1			0-1	0-1		
1. Physiological characteristics			0-1	0-1	0-1	0-1	0-1				0-1	0-1		
2. Biochemical reactions			0-1	0-1	0-1	0-1	0-1	0-1			0-1	0-1		
3. Antigenic structures and serological identification		0-1	0-1	0-1	0-1	0-1	0-1	0-1			0-1	0-1		
D. Specimens	0-1	0-1	0-1	0-1		0-3	0-3	0-1	0-1		0-3	0-3	0-1	
1. Sources		0-1	0-1	0-1		0-2	0-2	0-1	0-1		0-2	0-2	0-1	
2. Processing	0-1	0-1	0-1	0-1		0-2	0-2	0-1	0-1		0-1	0-2		
E. Interpretation and/or trouble shooting			0-2	0-1	0-1		0-1	0-1						
VI. Parasites	4-6 questions					1-3 questions					2-3 questions			
A. Morphology	0-1	0-1	0-1			0-1	0-1				0-2	0-2		
1. Shape	0-1	0-1				0-1	0-1				0-2	0-2		
2. Structures	0-1	0-1	0-1			0-1	0-1				0-1	0-1		
B. Specimens	0-1	0-1	0-1			0-1	0-1				0-1	0-1		
1. Sources	0-1	0-1	0-1			0-1	0-1				0-1	0-1		
2. Contaminants and artifacts	0-1	0-1	0-1			0-1	0-1				0-1	0-1		
C. Life cycles	0-1	0-1	0-1											
VII. Media preparation and reagents	1-2 questions					5-8 questions					3-7 questions			
A. Principles	0-2	0-1	0-1			0-1	0-1	0-1			0-2			
B. Procedures						0-3	0-3	0-2			0-4	0-3	0-2	
C. Interpretation and/or trouble shooting			0-2	0-1	0-1		0-1	0-1						
VIII. Disinfection and sterilization	1-2 questions					3-7 questions					3-6 questions			
A. Principles			0-2			0-2	0-1	0-1			0-2			
B. Procedures						0-3	0-2	0-1			0-3	0-3	0-2	
C. Interpretation and/or trouble shooting			0-2					0-1	0-1					
IX. Quality control	1-2 questions					1-2 questions					1-2 questions			
A. Procedures			0-1	0-1	0-1	0-2	0-1	0-1			0-2	0-1		
B. Principles			0-1	0-1	0-1	0-1	0-1	0-1			0-1			
C. Method comparison and/or development			0-1	0-1	0-1									
D. Interpretation and/or trouble shooting			0-1	0-1	0-1									

Attachment

Instructions for Use of Travel Forms

1. Complete one attached sheet and return to Hannah for reimbursement when your total expected reimbursement is greater than twenty (20) dollars. This is to be computed on the basis of:

   a) $ .18 a mile to and from your place of employment and/or home for the committee and subcommittee meetings.

   b) all toll and/or parking receipts

2. Send the completed form and all receipts (toll and parking) to:

   Hannah D. Zane
   School of Allied Health Professions
   CMDNJ
   100 Bergen Street
   Newark, N.J. 07103

3. The check will go to your work address unless Hannah is notified otherwise.

CMDNJ-SCHOOL OF ALLIED HEALTH PROFESSIONS

MONTHLY TRAVEL REPORT FORM

Name: ______________________________

Title: ______________________________

Travel Account Number: ______________

Period Including: ______________, 19 ___ to ______________, 19 _____

Date	Trip	Purpose	Total Mileage	Tolls	Other
		TOTALS			

Signed: ______________________ Anticipated Reimbursement ______________

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MINUTES OF COMMITTEE MEETING

WEDNESDAY, APRIL 8, 1981
CMDNJ   Newark, New Jersey

In attendance: Madeline Bonadies, John Davis, Heidi McGraw, Suzanne Roth, Robert Del Guidice, Kuldip Sandhu, Bruce Storm, Les Stutzman, Anna Gargantiel, Jeanette Sanducci, Mary Wethington, Hannah Zane, Madeline Ducate, Rennie Miller

Absent: Judy Allen, Diane Armington, Elaine Keohane, Susan Mikorski

The second meeting of the MLT/MT Microbiology Examination Committee was held on Wednesday, April 8, 1981, at CMDNJ with Madeline Ducate presiding.

From 10 am til 12:30 pm, a minisession was conducted that took the participants through the various steps involved in the construction of a criterion-referenced examination. Attachment (A) is the agenda outlining these steps. Exercises and examples were utilized to demonstrate and reinforce the tasks involved.

A brief business meeting was conducted during a delicious lunch of deli sandwiches (made to order) and soda.

Time Table of Tasks of the Subcommittee

The tasks as outlined in the agenda were reviewed and deadline dates set for their completion.

Task A: Content Outline (Table of Specifications)--requires review and modification of the ASCP Grid and the ASMT Body of Knowledge Content Outline. Due Date: April 30, 1981

Task B: Behavioral Objectives--requires the review and selection of behavioral objectives that will fir into the table of specifications developed by the subcommittees. Behavioral objectives were donated for the committee's use by Felician College, Somerset Medical Center, MetPath School of Medical Technology, CMDNJ-SAHP's Medical Technology Program and from those published by ASM in the ASM News, 1979. Due Date: April 30, 1981

Task C: Design of exam items and assignment of Minimal Pass Indices (MPIs)--Exam items have been and are being collected from numerous sources and will be distributed to the subcommittees for item editing and grid referencing. In addition, original items will be constructed to complete the 100 questions for each level (MT and MLT) needed. The subcommittee will then assign an MPI value to each item. The chairmen will be provided forms to use for their items, grid reference and MPIs. These forms are due: May 30, 1981.

All task assignments are to be sent to Madeline Ducate who will review, collate and retype as needed the assignments. The exam items and MPIs will be used at the Peer Review Meeting to be held on June 15, 1981. The purpose of this third general meeting will be to peer review the questions and MPI assignments and adjust as needed. All expense forms will be due on this date in order that the final budget can be submitted by June 20, 1981 to the State for reimbursement.

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The final report which will include the exams (2 forms of a MLT equivalancy exam and 2 forms of a MT equivalency exam) will be completed and sent to the committee members by mid-July. Confidentiality will be asked until the model tool for equivalency testing can be normed on the graduating classes of MLTs and MTs in the spring of 1982.

Subcommittee Finalization

Readjustment of the subcommittee composition was made since 5 persons have dropped from the project and 2 new persons have joined our venture. See revised listed. (Attachment B)

Subcommittee Chairmen

Each subcommittee selected chairmen to coordinate their activities. These "volunteers" are noted on the revised list.

Clarification of organisms on Committees #1 and #2

Some clarification of the gram negative bacilli assigned between the two subcommittees was needed. Subcommittee #1 will now be called "Nonfastidious Gram Negative Bacilli and Anaerobes", Subcommittee #2 will remain "Other bacteria including Mycobacterium"

Number of Questions

It was reaffirmed that each subcommittee will submit a total of 200 questions, 100 for the MLT examinations and 100 for the MT examinations.

Availability of a typist

Each subcommittee was asked to submit their forms to Madeline legibly who will see that the products are typed for final copy.

Kodachromes/Pictures

Due to the expense involved, Kodachromes will not be used in the equivalency exams. However, sketches and drawings would be most appropriate to use in the mycology/ parasitology section.

The meeting was adjourned at 1:30 pm. The subcommittees then met separately to organize their activities.

Respectfully submitted,
Madeline
Madeline Ducate

List of Committee Members

Revised: April 8, 1981

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SUBCOMMITTEES

Revised 4/8/81

Group 1 Nonfastidious Gram Negative Bacilli & Anaerobes

Mary Wethington, Microbiology	(V.A. Hospital)
*Anna Gargantiel, Microbiology	(St. Joseph's Hospital)
Suzanne Roth, Microbiology	(St. Joseph's Hospital)
Heidi McGraw, MT Program	(Morristown Memorial Hospital)

Group 2 Other Bacteria and Mycobacteria

*Rennie Miller, MT Program	(Medical Center at Princeton)
Kuldip Sandhu, PhD, Microbiology	(Jersey Shore Medical Center)
Judith Allen, MLT Program	(Our Lady of Lourdes Hospital)
Elaine Keohane, MT Program	(CMDNJ)

Group 3 Mycology & Parasitology

Les Stutzman, Microbiology	(Somerset Medical Center)
*Madeline Bonadies, MT Program	(Somerset Medical Center)
Diane Armington, MLT Program	(Mercer County Community Colleg
Susan Mikorski, MT Program	(CMDNJ)

Group 4 Miscellaneous

*Bruce Storm, MT Program	(St. Michael's Hospital)
Jeanette Sanducci, MT Program	(Mountainside Hospital)
John Davis, PhD, Microbiology	(Mountainside Hospital)
Robert Del Guidice, Lab Admin.	(Newark Beth Isreal Medical Ce

* chairmen

TOPICS IN EDUCATION

The Use of Examination Content Guidelines in Teaching Clinical Microbiology[†]

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The concept of using examination content guidelines as sources for curriculum content is presented, using the ASCP Board of Registry grids and a task list developed for HEW as a basis for proficiency examinations. The grid structure is related to Bloom's taxonomic levels, and a brief explanation of each level is included. A comparison of the grid structure and task list format is made, and specific examples of the use of each are offered.

INTRODUCTION—Three sources have been suggested for curriculum inclusions—the opinion of subject matter experts, society's expectations of graduates' competence, and the expectations of the students themselves.[3] The curriculum guides discussed here provide at least the first two of these sources. These guides are: 1) the American Society for Clinical Pathologists' (ASCP) Board of Registry examination content guidelines or "grids" developed by the ASCP Committee on Medical Laboratory Personnel and 2) a task list developed by the Professional Examination Service for the Department of Health, Education and Welfare (HEW) for its proficiency examinations.

One might ask, "Why do we need guides at all?" The guides are needed to ensure that all necessary material is included in the curriculum. An advantage of the grid structure is that it tells what the students may be expected to do with the information, or, in educational language, at which taxonomy level they are to function. Actually, the guidelines were not developed to serve as curriculum guides, since each program should design its own curriculum based on its own unique situation. However, it would be a bit short-sighted of an instructor to know that a given topic would be covered on an examination and not include that subject matter somewhere in the curriculum.

An examination of the various guidelines in toto shows that, for example, only two or three questions may be asked about a topic such as research and development. This is not an indication that such a topic is not important enough to teach but an indication of the relative amount of time that should be given to it.

It is essential to remember that any curriculum developed using the guidelines discussed would be a minimum curriculum. It is up to each program to determine how far beyond this minimum it is realistic to go, given time and money constraints and the educational level of students.

An informal poll of microbiology teachers showed a range of uses of the guidelines from "not at all" to "read through for a general content guide" to an extensive use of the Board of Registry grid in weighting the amounts of time given to teaching the various topics and in updating course content by adding and deleting topics. One community college used the HEW task list as an outline for a course called "Clinical Lab Review," designed to help laboratory employees prepare for the HEW proficiency examination. The task list was given to each student in the course as a study guide.

There are two formats in common use at the present time—the task list (HEW and the American Society for Medical Technology's competence statements) and the grid, published in the Board of Registry's examination content guidelines. The grid format is easy to use for comparison of personnel categories.

Bloom's *Taxonomy of Behavioral Objectives: Cognitive Domain* was utilized in the development of the grids because it has been widely accepted. The Board of Registry had previously used it in writing examinations, and practioners were familiar at least with taxonomy levels I, II, and III.

Figure 1 is a portion of the microbiology grid. The vertical axis lists content, and the horizontal axis lists taxonomy level. The three personnel categories are listed side by side. The numbers in the squares are the maximum number of questions that may be asked on that topic.

Differences in functions expected of the three personnel categories are reflected in the taxonomy levels at which questions are asked. For instance, in item XII, Pathogenicity, the clinical laboratory assistant (CLA) may be questioned at levels

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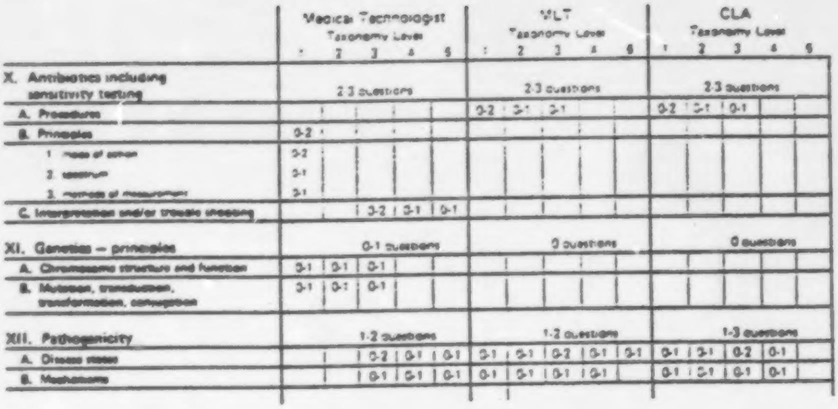
[†] *This paper and another which appears in this issue, Judith T. Barr's "Development of a Ladder Curriculum in Clinical Microbiology," are 1979 updates of presentations made as part of the "Symposium on Education in Clinical Microbiology" at the 45th Annual Meeting of the American Society for Medical Technology in Atlanta, Georgia, June 1977.*



	Medical Technologist Taxonomy Level					MLT Taxonomy Level					CLA Taxonomy Level				
	1	2	3	4	6	1	2	3	4	6	1	2	3	4	6
X. Antibiotics including sensitivity testing	2-3 questions					2-3 questions					2-3 questions				
A. Procedures						0-2	0-1	0-1			0-2	0-1	0-1		
B. Principles	0-2														
1. mode of action	0-2														
2. spectrum	0-1														
3. methods of measurement	0-1														
C. Interpretation and/or trouble shooting			0-2	0-1	0-1										
XI. Genetics — principles	0-1 questions					0 questions					0 questions				
A. Chromosome structure and function	0-1	0-1	0-1												
B. Mutation, transduction, transformation, conjugation	0-1	0-1	0-1												
XII. Pathogenicity	1-2 questions					1-2 questions					1-3 questions				
A. Disease states			0-2	0-1	0-1	0-1	0-1	0-2	0-1	0-1	0-1	0-1	0-2	0-1	
B. Mechanisms			0-1	0-1	0-1	0-1	0-1	0-1	0-1		0-1	0-1	0-1	0-1	

Figure 1: A portion of the microbiology grid published by the American Society of Clinical Pathologists' CMLP Newsletter.[1]

through four, the medical laboratory assistant (MLT) at all levels, but the medical technologist (MT) only at three, four, and six. This is based on the assumption that the ability to function at the higher levels implies accomplishment of lower level knowledge.

A brief explanation of the taxonomy levels of the cognitive domain, as defined by Bloom (Figure 2), follows.

TAXONOMY LEVELS—What is a taxonomy level? In the cognitive domain, it is a hierarchy of skills and thought processes used in dealing with knowledge. The first level is recall, indicating that one must have a foundation of known facts with which to work. From there, it proceeds upward, with each level depending on the preceding one—you cannot comprehend what you don't know or apply what you don't understand.

Because a question is at a higher taxonomy level, it is not necessarily more difficult. There can be hard questions at levels I and II, and easy ones at levels IV and VI. What the student is asked to do with knowledge is what differentiates the taxonomy levels and determines how the questions are labeled. Level V (synthesis) is not currently a part of the Board of Registry examination process. It is important, but because it involves activities which are not appropriate to the multiple choice question format (for example, producing an original plan) it is omitted. The taxonomy levels and some appropriate verbs for each are illustrated in Figure 2.

At level I, all the student is asked to do is to return information. This is simple recall, based on either recognition or memorization. This may involve a wide range of material, from specific facts to complete theories, but all that is required is memory.

At level II a little more is asked of the student. He must do something more than just remember. For example, he may perform a basic calculation, given the formula, to prove he understands the concept. Bloom's definition of level II is: "Taxonomy Level II—Comprehension or Simple Interpretation—The ability to grasp the meaning of given information. This may be shown by translating material from one form to another, interpreting material or recognition of relationships among given data."[2]

Level III takes the student a step farther. He must apply his understood knowledge, use learned material in new situations or problems, or select previously learned information to provide a solution to a new problem.

Level IV is much more complex. Here the student's ability to break down a situation to its components and to analyze elements, relationships, and/or principles and their organization is tested. This flows from application into evaluation, making it sometimes difficult to make a firm differentiation between the two. Bloom says that analysis most often is "an aid to fuller comprehension or a prelude to an evaluation."[2] Gronlund points out that analysis requires "an understanding of both the content and the structural form of the material."[4]

Level V, synthesis (not included in Figure 2), refers to the ability to put parts together to form a new whole, such as a unique communication (theme or speech), a plan of operations (research proposal), or a set of abstract relations (scheme for classifying information). Learning outcomes (behavioral objectives) in this area stress creative behaviors, with major emphasis on the formation of new patterns or structures. These activities are extremely difficult to measure with a multiple-choice exam. Nevertheless, if it is important that a technologist graduating from a program be able to perform at this level (for example, design a system for quality control in microbiology), the instructor should write objectives accordingly, teach by them, and then test the students over them, utilizing an appropriate format.

At the top, level VI, the student is asked to integrate all he has learned and evaluate the results, principles, or relationships previously analyzed. He will be using some very high-level cognitive activities—making judgments based on evidence about the validity of data, accuracy of work, or fitness to selected criteria. As a rule of thumb on level VI, these activities require at least two sets of criteria to make the judgment. A general framework for these questions is: "What does this mean, and what should be done about it?" These questions go one step farther than analysis.

EVALUATION

judge
appraise
evaluate
rate
value
revise
score
choose
assess
estimate
measure
conclude
justify

ANALYSIS

distinguish
analyze
differentiate
test
compare
contrast
criticize
diagram
inspect
inventory
question
relate
examine
categorize
break down
point out
separate

APPLICATION

interpret
apply
employ
demonstrate
illustrate
compute
manipulate
modify
prepare
relate
solve
calculate

COMPREHENSION

translate
restate
describe
recognize
explain
express
identify
locate
review
convert
distinguish

KNOWLEDGE

define
repeat
record
list
recall
name
relate
identify
label
match
select

Figure 2: Illustration of five of the six taxonomy levels with descriptive verbs. Reproduced in the ASCP Board of Registry's Question Writer's Handbook.[1]

UTILIZING THE GRIDS—As previously discussed, the grids indicate levels of function as well as content areas. It would be a rare student who could respond at level VI after being taught and tested at level I for a year or two. Instructors who restrict their students to the recall or comprehension levels do these students a disservice because they are asked to analyze and evaluate as soon as they graduate and move into a work setting.

This implies the value of using the grids in stating course objectives. If an instructor feels it is important, for example, that students be able to evaluate a new system for the identification of enterics, he should state that as an objective and teach by it. Then, using the grids for content and levels, the instructor should test them on that objective. Referring to Bloom's *Taxonomy* for a description of the various levels of function expected in each area should make the task of stating objectives considerably less tedious.

In part three of the microbiology grid, "Enterics and other gram-negative rods," the topic in section B4 is "cultural characteristics—colonial appearance." All three personnel levels may be asked questions on this topic, with the MT expected to respond at all levels, but the MLT and CLA only at level I. Thus, an objective for the MLT and CLA might be: "The student will be able to describe the appearance of *Escherichia coli* on standard media," with the exam question asking either, "What does *E. coli* look like on (a given medium)?" or "The following describes the colonial morphology of an organism. Identify it." (At the bench, the student would be expected to recognize the colonies on specified media.) The medical technologist would be expected to do all of the above, as well as employ information at higher levels, such as

11:05 Maintain stock cultures for quality control programs (selection and maintenance of organisms for media and reagent controls).

including:

- 11:15 Prepare and evaluate quality of culture media (using commercially dehydrated products, e.g., McConkey, SS, infusion bases).
- 11:25 Establish validity of culture media
- 11:35 Establish validity of microbiologic reagents
- 11:45 Establish validity of antibiotic disk reactivity

11:10 Know methodology of staining bacteria (simple and differential stains)

Figure 3: HEW Consolidated Task List. Reprinted with permission from Clinical Laboratory Technology Proficiency Examination. *New York, Professional Examination Service, contract number HSM-110-73-529, DHEW, Division of Provider Standards and Certification.*

use colonial morphology as a basic step in a protocol, differentiate *E. coli* from other organisms, or be able to explain the biochemistry which produces colony color.

A practical use of the grids is as a framework for course exam construction. Assuming that the instructor has valid objectives, he can use the grid technique to blueprint examinations based on his own objectives. If he does not have objectives for all areas of his curriculum, he can still use the grid technique to determine what content matter should be covered on each exam, what taxonomy levels to include, and how many questions to ask at each level. This technique helps to ensure a fair and complete distribution of questions and helps to avoid too many on the instructor's favorite topics. Testing is conducted to determine if students have achieved the objectives the instructor developed for the course, not to see how successfully students can "psych out" the instructor. Exams are, in the former context, a good measure of the adequacy of instruction.

The purpose of any certifying examination is to attest to the competence of practitioners at career entry. As such, it is the ultimate evaluation of students and curriculum. The school reports provide a breakdown by disciplines of students' performance compared with the national means. This, too, is one mechanism to assess the strengths and weaknesses of any program.

THE HEW TASK LIST—Figure 3 is a sample of the HEW guidelines. These are in the form of a task list and were derived by the Professional Examination Service under contract number HSM-110-73-529 with HEW's Division of Provider Standards and Certification. The task list is an appendix to a report entitled *Clinical Laboratory Technology Proficiency Examination.** This is a totally different structure from the grids. No attempt was made to integrate any taxonomy or levels of function required. Only one personnel level is considered, the tasks are much less specific than the outline used with the grids, and the overall listing is less comprehensive; however, the task list has its uses.

UTILIZING THE TASK LIST—The task list has been used successfully for exam preparation. It was the community college medical laboratory technology faculty in response to needs expressed by area laboratory personnel. The course was designed specifically for those intending to take the HEW proficiency exams, and each student received a copy of the task list. The course met four nights weekly for six weeks and was team taught. All of the necessary material could not be covered in 24 sessions, but students' areas of weakness were identified. Each student was assisted in planning his preparation for the exam. The college's MLT comprehensive exam was given as a pre- and post-test, and the scores indicated significant improvement.

SUMMARY—It is thus evident that the two types of guidelines discussed can be used as a foundation for planning and evaluating educational programs on which each institution may build its own unique curriculum.

Acknowledgments—Figure 1 is reproduced with permission from the American Society of Clinical Pathologists, *CMLP Newsletter,* October 1974, p 10, and Figure 2 is reproduced with permission from Macmillan Company, New York, New York.

References

1. ASCP Board of Registry: Question Writers' Handbook. Chicago, American Society of Clinical Pathologists, 1975, p 9.
2. Bloom, B S (Ed.): Taxonomy of Educational Objectives: Cognitive Domain. New York, David McKay, Inc., 1969, p 144.
3. Examination content guidelines: Clinical microbiology. CMLP Newsletter, October, 1974, p 10.
4. Gronlund, N E: Stating Behavioral Objectives for Classroom Instruction. New York, Macmillan Co., 1970, p 21.
5. Tyler, R W: Basic Principles of Curriculum and Instruction. Chicago, The University of Chicago Press, 1970, pp 5, 16, 25. ■

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TOPICS IN EDUCATION

A Ladder Curriculum in Clinical Microbiology[†]

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A continuum of four microbiology courses for medical technology majors has been developed by the Medical Laboratory Science Program at Northeastern University. Using a systems approach to curriculum design, the academic and clinical faculty identified career-entry capabilities, delineated appropriate subject content, and developed an instructional system which placed individual topics into one of four courses in the ladder curriculum: a basic, second-year, university-based clinical microbiology course stressing microbial technique and common organism identification; third-year microbiology and cellular physiology courses developing theoretical aspects; a fourth-year, hospital-based clinical microbiology rotation emphasizing isolation and identification techniques for significant pathogens; and a fourth-year, university-based, didactic course covering host defense-organism virulence interactions, infectious disease principles, and new techniques and unusual isolates as reported in the recent journal literature. Based on four years of experience with this system and in light of the publication of the 1978 American Society for Medical Technology (ASMT) Competency Statements, the Northeastern Medical Laboratory Science Program faculty is currently reexamining the continuum to insure completeness and appropriateness of overall subject content, to provide reinforcement, and to remove unnecessary duplication among the courses in the curriculum.

INTRODUCTION

Needs Assessment

In many medical technology programs, the microbiology component is divided into two unconnected sections: 1) a theoretical microbiology course traditionally taught by the biology department, and 2) the clinical microbiology lecture and laboratory component offered during the clinical experience. This was basically the organization of microbiology courses for medical laboratory science (MLS) majors at Northeastern University in 1975 when a curriculum review suggested that a ladder curriculum be developed for the clinical microbiology sequence of the integrated, five-year MLS program.

The review indicated that the current microbiology sequence had several major problems which could be solved by the development of a ladder curriculum, which would include the introduction of a new second-year basic clinical microbiology course.

One problem, identified by the hospital-based clinical faculty, was that the students arriving for the hospital microbiology component had little understanding of clinical microbiology and had very poor laboratory technique. Although one solution would have been to modify the laboratories in the biology department's microbiology course, it was felt that a better answer would be to create a new basic-level clinical microbiology course which would stress common organism isolation and identification techniques and theory.

[†] *This paper and another which appears in this issue, Judeth A. Crowley's "The Use of Examination Content Guidelines in Teaching Clinical Microbiology," are 1979 updates of presentations made as part of the "Symposium on Education in Clinical Microbiology" at the 45th Annual Meeting of the American Society for Medical Technology in Atlanta, Georgia, June 1977.*

The second problem centered around the desire for a curriculum which would offer two common years (six quarters) for both the associate degree medical laboratory technician (AD-MLT) and the baccalaureate degree medical laboratory science (MLS) student. This would permit students to enroll in two AD-MLT clinical experience quarters after completion of the common first and second year or to continue in the five-year MLS curriculum.

However, the curriculum review identified a deficiency in the second year: there was no provision for a basic clinical microbiology course within the common second year, and hence the AD-MLT students entered their two quarter AD-MLT experience without a microbiology background. The inclusion of a basic course in the second year would meet several needs. It would provide a necessary course for the AD-MLT program, it would become a part of the common AD-MLT and MLS first- and second-year component, and it would provide the first rung of the microbiology sequence which would be further developed in other segments of the five-year curriculum.

The last major concern centered around Northeastern University being a cooperative education institution, and this point must be a concern for any institution considering the cooperative plan. At Northeastern University after five academic quarters, students are placed in work experiences commonly called co-op jobs. For the remainder of their university program, they alternate between their co-op jobs and academic quarters; the AD-MLT students have three co-op quarters, and the MLS students have six. During these noncredited university quarters, the students work for a salary, usually as an assistant in a health-related laboratory situation. It is to be emphasized that these co-op jobs are for work experience only and do not take the place of the regularly structured clinical experience.

However, for students to maximally benefit from their co-op jobs, it is important that programs offer basic medical laboratory science courses prior to the first co-op placement. This arrangement provides the students with a basic level of understanding of the clinical laboratory and with skills in some basic laboratory techniques. Therefore, the inclusion of a basic second-year clinical microbiology course scheduled prior to the first co-op quarter improves the co-op experience and makes it more beneficial for both the student and the employer.

Based on these three major factors, the Northeastern traditional microbiology curriculum was expanded to include a basic clinical microbiology course in the second year. This course became the first step in the ladder curriculum and provided a firm foundation for developing a clinical microbiology continuum in this subject area. Topics were further developed and skills perfected in the other courses in the ladder curriculum.

A SYSTEMS APPROACH TO CURRICULUM DESIGN—Rather than a random assignment of topics to specific courses within a ladder curriculum, it is critical to identify what subject material should be included in the total clinical microbiology sequence. To do this properly, one must go one step further and identify the skills and knowledge necessary for a successful graduate ("product") of the instructional system. It is basic to a systems approach to curriculum design to define the product of the instructional system.[7] In this case the product is a clinical laboratory scientist with career-entry capabilities in clinical microbiology. The theory behind this approach is that it is better to know in the beginning of the process what the educational product is to be and then design the courses rather than to structure the microbiology courses without any concept of the terminal goal.

Various outside factors affect the product and influence the definition of the role and function of the career-entry clinical laboratory scientist in clinical microbiology. All of these must be examined and considered when defining the product. These factors include accreditation and certification requirements, legislation, government regulations, hospital and university requirements, and statements issued by professional organizations which describe career-entry capabilities, delineate competency statements, and identify the required body of knowledge for that profession. Figure 1 illustrates all of these external influences which were considered in the composite definition of the Northeastern graduate.

A major external influence on the definition of our product is the American Society for Medical Technology, which constantly examines the role and function of the clinical laboratory scientist. In 1973 "ASMT Position Paper: Differentiation Among MT, MLT, and CLA Expected Capabilities at Career Entry" was published.[1] A competence delineation statement followed which itemized medical technologist level capabilities and responsibilities for both scientific and administrative positions.[4] Recently the "Career Entry Statements of Competence: Clinical Laboratory Sciences," which expanded the earlier documents, was completed.[3] In the near future, the ASMT Competence Assurance Council will be developing "The Body of Knowledge of Clinical Laboratory Sciences," which will delineate the knowledge, skills, and attitudes needed to perform each of the tasks in the clinical laboratory.[6] All of these either are or will be vital documents to analyze and incorporate into each program's definition of a product of its instructional system. To design a curriculum without these valuable references is to ignore the current state of the art.

Certification considerations should also be included in the product definition. Presently most certification examinations evaluate career-entry capabilities and, when

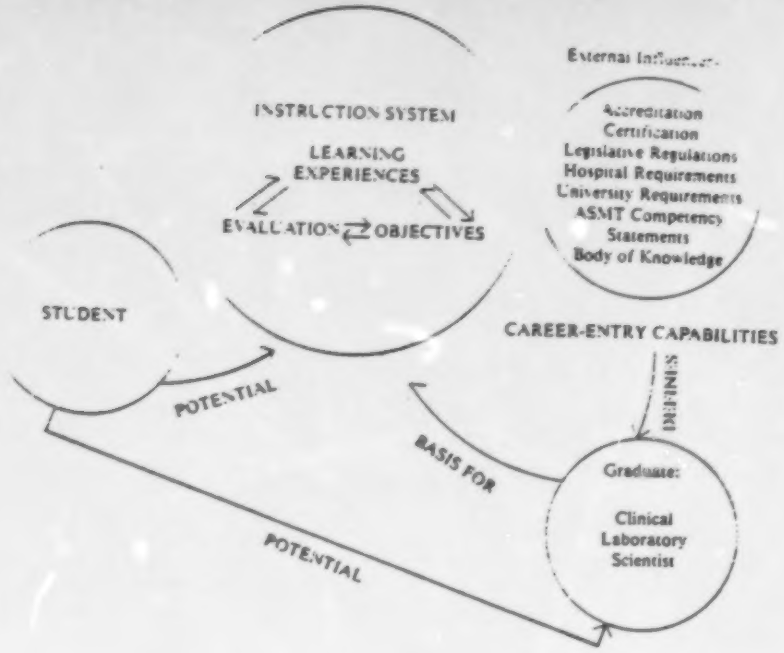

Figure 1. A systems approach to curriculum design.

properly constructed, determine if the graduate possesses a subset of these capabilities. This indirectly measures the instructional system. The examination of the National Certification Agency for Medical Laboratory Personnel is criterion-referenced to the "Career Entry Statements of Competence" and therefore assesses knowledge that has been identified as a necessary component part of a knowledgeable graduate.

Another certification examination, the American Society of Clinical Pathologists (ASCP) Board of Registry examination, is also designed to measure career-entry capabilities. In theory, any question on the Registry certification examination is an appropriate topic for the career-entry individual and should be included in the overall instructional system. In October 1974 the ASCP's Commission on Medical Laboratory Personnel (CMLP) Newsletter published the Registry examination content guidelines for the microbiology section.[3] These guidelines or "grids," as they were soon called, serve as a rough content outline and indicate the appropriate question taxonomy level[1] for CLA, AD-MLT, and MT examinations as perceived by the Board of Registry.

As is clearly stated in the October 1974 CMLP Newsletter, "It is not the purpose of these guidelines to define or prescribe the detailed goals and objectives of the educational process."[3] However, many educators have taken these guidelines and have completely structured their course content upon the content outline. Rather than creating a product definition which included other non-Registry examinable attributes, they have allowed the guidelines developed for a paper and pencil examination to serve as the major factor in their definition of a clinical laboratory scientist.

Other factors must be included in the definition process. Universities have a commitment to educate the graduate not only for career entry, but also for continued growth within the profession. It is essential that a newly graduated clinical laboratory scientist be able to adapt to new techniques and be aware of new developments which may affect the laboratory in the near future. Therefore, a university must insist that the final definition of the product include the factor of potential growth.

[illegible] the [illegible] the [illegible] nical competen[illegible] reer entry. Once an [illegible] is defined, the clinical [illegible] can be structured to meet that [illegible].

Also, the National Accreditation Agency for Clinical Laboratory Science (NAACLS) indirectly contributes to the definition of the product by accrediting the educational process which produces the career-entry clinical laboratory scientist. Any changes in NAACLS requirements, required courses, and established procedures may influence and alter the product definition for a program engaged in this process. The same relationship may exist within areas where state and/or federal legislation influences the licensing or regulation of clinical laboratories and/or personnel and, thus indirectly, the definition of the product.

After all factors which influence the definition of a career-entry clinical laboratory scientist have been examined and a working definition has evolved, one may then consider the instructional system.[1] The product definition serves as the basis for the instructional system and its curriculum design. Objectives would be developed for the identified topics,[7] learning experiences would be designed, and evaluation tools would be constructed. All three of these are interactive components of the educational system and never should be considered as separate, mutually exclusive units. One should use the results of students' evaluations to reexamine objectives and learning experiences, just as one uses the objectives to design learning experiences and evaluations. Any redefinition of the needed career-entry skills and capabilities of the product would then necessitate a redesign of the instructional system.

COURSE CONTENT—As a result of the analysis of the external influences of 1975, a definition of a graduate of Northeastern's MLS program was developed. This enabled the faculty to delineate appropriate subject content and then to assign topics to one of the four courses in the ladder curriculum. The four courses, briefly summarized below, provide a continuum of clinical microbiology material over a three-year period.

1. Basic Clinical Microbiology (Basic)
Offered during the second year, this course has 3 lecture hours and 6 lab hours per week during an 11-week quarter. The emphasis is on mastery of a limited number of major topics, such as identification techniques for staphylococci, streptococci, and enterics; specimen handling and collection; and normal versus abnormal flora in various body sites. The laboratory develops the basic techniques needed for organism isolation and identification.

2. Microbiology and Cellular Physiology (Theoretical)
These two third-year courses are taught by the biology department and cover theoretical aspects of microbiology. Energy production cycles, membrane transport, toxins, and microbial genetics and metabolism are some of the topics discussed. Because of the earlier microbiology laboratory sessions, the students only enroll in the weekly three-hour lecture component of the course, and the laboratory sessions accompanying the microbiology course are waived.

3. Clinical Microbiology (Applied Study)
During the clinical experience, the students rotate through the clinical microbiology laboratory for 11 four-day weeks. This in-hospital, applied study period stresses current procedures for the identification of bacteria, mycobacteria, and fungi and develops laboratory proficiency. Students work with a wide range of organisms as well as all types of human specimens.

4. Clinical Microbiology (Didactic)
The weekly five-hour university didactic course emphasizes host-organism interactions, unusual or newly recognized pathogenic organisms, and new procedures which will be in the clinical laboratory in the near future. Current journal literature is used extensively throughout the course.

TABLE I
ENTERICS

Year	Course	Topics
Second	Basic	Characteristics of Enterobacteriaceae Principles of major enteric media reactions Common enteric biochemical identification Introduction to antigenic identification
Third	Theoretical-Biology	Energy production and pathways Enzyme systems Toxin production
Fourth	Applied Study	Review of enteric media Common and unusual enteric identification Antigenic identification
Fourth or Fifth	Didactic	Commercial enteric identification systems Host-organism interaction

These four rungs in the ladder curriculum are designed to allow the students first to establish a firm foundation of basic clinical microbiology, to add to this foundation the theoretical aspects of general microbiology, and finally to build upon these courses by further development of laboratory competence in the applied study course and by the addition of current and more advanced didactic clinical microbiology material.

After the faculty defined the graduate of the instructional system and determined the necessary knowledge and skills, it was then possible to analyze each major subject area and logically place the material among the four courses in the continuum. Table I is a summary example of how this was applied to the enteric section.

This four-part approach allows major clinical subject material to be sequentially developed and distributed over three years rather than being compressed into one clinical rotation. The basic clinical microbiology course establishes a firm foundation and the additional courses complete the ladder curriculum.

As described above, Northeastern MLT students take the basic course and then progress to AD-MLT applied study. If they wish to return to the baccalaureate program, they enter the third year of that program and move to the second rung of the microbiology ladder.

FACULTY INPUT—From 1975 to 1978 the microbiology academic and clinical faculty members met periodically to plan, review, and evaluate the clinical microbiology curriculum. This group, composed of the basic clinical microbiology course and laboratory instructors, MLT applied study instructors, MLS applied study instructors, didactic course instructors, clinical and educational coordinators, and initially a representative from the biology department, determined the total clinical microbiology content and placed topics in the appropriate course. Often smaller groups met to examine a limited aspect of the total program.

With the 1978 publication of the ASMT Competency Statements, an intensive and extensive redefinition of graduates' career-entry capabilities was indicated. This has lead to a reassessment of the completeness and appropriateness of overall subject content and to a complete review of the instructional system. Once the necessary content has been determined, it will be placed in the appropriate course within the ladder curriculum and course objectives will be revised.

EVALUATION—Students rated the second-year basic clinical microbiology course highly. Ninety-one percent felt that the course was valuable and contributed to their understanding of the subject, and 66 percent considered the course to be out-standing, with an additional 25 percent ranking it as above average. The clinical microbiology co-op employers have found that completion of this course greatly reduced each student's job orientation time. Also they subjectively felt that the course enriched the co-op experience and that the subject content was appropriate for the second-year level.

The MLT clinical faculty have indicated that the principles and techniques in the basic course are directly applicable to the third-year MLT clinical experience. While the MLT clinical faculty were satisfied with the course, the MLS clinical faculty identified an important weakness—not in the course content, but in placement in the curriculum. Because the course is in the second year, more than two years could elapse before the students applied the basic concepts to in-hospital laboratory experience. During this time the students forgot the basic course material, and the clinical faculty were repeating much of the lecture and laboratory material. This wasted valuable time in the applied study course and negated the ladder concept by not allowing the student to progress to the next level without repeating earlier material.

In an attempt to solve this problem, a series of self-paced package reviews will be developed. Students will be required to complete the basic clinical microbiology course review series before they will be eligible to begin the applied study section. The series will be evaluated to determine if it is an effective solution to the identified gap between rungs of the ladder.

The second course in the sequence has presented some problems. Although the biology instructors have been very cooperative and provided the program with lecture schedules and outlines, the lack of objectives has made it difficult to gain a complete understanding of the course's scope and depth. The faculty will be working with the biology department to better integrate their courses into the ladder curriculum.

Primarily because of the time lost in duplication of earlier presented material as described above, the applied study course has not been as effective as originally planned. With the development of the review series, this problem is expected to be resolved.

The fourth and final rung, the didactic component, had received average to above average student evaluation. Fourteen percent of students rated the course superior, 34 percent above average, and 26 percent as average. In analyzing the responses, it was apparent that the everpresent problem in clinical laboratory science had affected the evaluation. Students were frustrated by material that they did not believe to be immediately or directly relevant to their perception of the role of the clinical laboratory scientist. Current journal information concerning future laboratory techniques was not of immediate application and appeared irrelevant. Theoretically educators should be able to infuse these students with the value of this type of material; however, it is easier said than done.

Finally, an evaluation of the entire ladder curriculum will not be possible until June when the first group of students who took basic clinical microbiology complete their baccalaureate program. A comprehensive evaluation of the ladder curriculum will be undertaken later this year.

FUTURE PLANS—Not all the external influences discussed in the systems approach section were available in 1975 when this ladder curriculum was first suggested. Now, in light of the 1978 ASMT Competency Statements and the activities of the ASMT Competence Assurance Council, the faculty is developing up-dated competency statements and career-entry definitions which are appropriate for Northeastern's program. These developments will alter the instructional system and lead to a re-examination of the continuum of course content and the assignment of topics to the proper rung in the curriculum. The evaluation will insure completeness and appropriateness of overall subject content, [illegible] duplication [illegible] attempt to [illegible] the issues raised [illegible]

SUMMARY—A four-rung ladder curriculum has been developed in clinical microbiology. Using a systems approach to educational design, the skills and knowledge necessary for the career-entry clinical microbiologist were first identified in 1975. An instructional system was developed and topics were assigned to the four rungs of the ladder. Presently the faculty is redefining the career capabilities of a clinical laboratory scientist in microbiology. This redefinition will incorporate recent competency and evaluative data and will lead to an evaluation of the current instructional system and an incorporation of newer procedures and concepts within the microbiology continuum.

References

1. ASMT position paper: Differentiation among MT, MLT and CLA expected capabilities at career entry. Am J Med Technol 39:362-64, 1973.
2. Bloom, Benjamin (Ed.): Taxonomy of Educational Objectives: Cognitive Domain. New York, David McKay Company, Inc., 1956.
3. Career Entry Statements of Competence, Clinical Laboratory Sciences. Bellaire, Texas, American Society for Medical Technology, 1978.
4. Competence delineation statement: Clinical microbiology. ASMT News, 1976.
5. Examination content guidelines: Clinical microbiology. CMLP Newsletter, October, 1974, p 10.
6. Fiene, Mary Ann: Competence council undertakes defining body of knowledge. ASMT News, March, 1979, p 3.
7. Mager, Robert: Preparing Instructional Objectives. Belmont, California, Lear Siegler, Inc./Fearon Publishers, 1962.
8. Thompson, Robert: A Systems Approach to Instruction. Hamden, Connecticut, Linnet Books, 1971. ■

CLINICAL LABORATORY SCIENCES

BODY OF KNOWLEDGE

CONTENT OUTLINE

Casmt

INTRODUCTION

"What is all knowledge too but recorded history; of which, therefore, reasoning and belief, no less than action and passion, are essential materials."

Thomas Carlyle 1795-1881

According to Thomas Carlyle's philosophy, if we do not record the realities of professional practice, we cannot define the profession. Thus, recording knowledge and experience is the key to understanding.

Today's clinical laboratory practitioners provide service in a wide variety of settings utilizing knowledge acquired from many types of educational experiences.

The results of those experiences, and the components that should be included in the practitioner's total knowledge, comprise the body of knowledge for the profession. This document is the first attempt to identify the comprehensive body of knowledge for clinical laboratory science.

This Body of Knowledge document is one of the foundation documents of the ASMT Competence Assurance System, along with the Scope of Practice, Philosophy, and Statements of Competence. Its purpose is to describe the theoretical and practical knowledge needed to function at various levels in the clinical laboratory science field.

I. Possible Uses

In addition to serving as a foundation for the Competence Assurance System, the Body of Knowledge document can:

A. Emphasize knowledge unique to the profession (i.e., knowledge not contained in other professional domains), thus defining the identity of clinical laboratory professionals in their relationships to consumers of their services and to other health professionals.

B. Serve as a basis for:

1. differentiating various levels of practice from laboratory assistant through clinical practitioner.
2. developing curricula and educational resources
3. developing assessment and certification exams

C. Serve as a basis for defining career mobility and the required educational content to achieve a higher level of practice.

D. Serve as a source document which, through periodic revisions, will reflect technical advances in the profession.

II. Developmental Process

Authors for the Body of Knowledge document were selected from laboratories and academic institutions by the chairpersons of the ASMT Scientific Assembly. This mechanism was designed to guarantee results that were job-related, as well as academically acceptable.

A dual approach was used to develop the Body of Knowledge document. To ensure that it contained all necessary practical and theoretical information, two different data collection mechanisms were used: the task-oriented or performance approach and the theoretical or textbook approach.

A. Task-Oriented Approach

The authors collected task-oriented data using "task delineation forms" which identify skills, information, and attitudes needed to perform specific tasks. The functions of the resulting task data include:

1. Providing a direct link to current laboratory practice.
2. Providing a systematic check and balance with the theoretical or academic approach.
3. Identifying information, attitudes and skills more specifically than possible with theory alone.
4. Ensuring the practicality and acceptability of the Body of Knowledge document.
5. Relating tasks (clinical performance) to academic pre-requisites.
6. Relating tasks to other tasks within the clinical domain, and to expanded professional roles.

B. Theoretical Approach

The theoretical or academic approach attempts to describe the professional body of knowledge in relation to the content of the arts, sciences, and humanities, as well as to the domains of other professions.

Sources for this approach were current textbooks, journal articles, and documents from major teaching facilities.

This approach resulted in a content outline which is a necessary companion to task-oriented information. The content outline:

1. Prevents neglect of non-technical content such as professional conduct, ethics, management, and communication skills.
2. Provides a framework for organizing task information.
3. Ensures incorporation of new horizons of knowledge, (i.e., what will be instead of just what is), thus highlighting areas for role expansion and professional growth.

III. Review Process

The draft document was made available to all interested professionals, including non-ASMT members, for review.

Volunteer reviewers were solicited through the ASMT News, through publicity at the ASMT national meeting, and through news releases to other peer and specialty organizations. Copies of the draft document were available at the national meeting (June, 1979) and from ASMT society headquarters upon request.

Review suggestions were collated and incorporated by the authors, to provide as up-to-date and useful a document as possible.

IV. Content

This document follows an outline format. Major sections of the outline correspond to major divisions of clinical function. Each section begins with an overview by the author(s). The broad sequence followed is from general to specific and from basic to advanced.

Professional Values and Characteristics is the first section because a clinical laboratory professional's success is closely related to motivation, enthusiasm, and satisfaction regarding the profession.

Although the urinalysis section is short, it has been kept as a separate section, since it contains knowledge which is unique to our profession.

Cytogenetics has been omitted from this outline. It will be represented by a separate section in the second edition.

V. The Future

This document will be updated periodically under the guidance of the ASMT Scientific Assembly. A section chairperson will select individuals to review and provide suggestions to the authors.

This document belongs to all practicing clinical laboratory professionals. It is our right to define its contents, our responsibility and duty to help monitor and up-date it, and our privilege to use it to promote our personal growth and enhance our professional stature.

Condensed Version of the
Taxonomy of Educational Objectives

Cognitive Domain

KNOWLEDGE

I. KNOWLEDGE

Knowledge, as defined here, involves the recall of specifics and universals, the recall of methods and processes, or the recall of a pattern, structure or setting. For measurement purposes, the recall situation involves little more than bringing to mind the appropriate material. Although some alteration of the material may be required, this is a relatively minor part of the task. The knowledge objectives emphasize most the psychological processes of remembering. The process of relating is also involved in that a knowledge test situation requires the organization and reorganization of a problem such that it will furnish the appropriate signals and cues for the information and knowledge the individual possesses. To use an analogy, if one thinks of the mind as a file, the problem in a knowledge test situation is that of finding in the problem or task the appropriate signals, cues, and clues which will most effectively bring out whatever knowledge is filed or stored.

1.10 KNOWLEDGE OF SPECIFICS

The recall of specific and isolable bits of information. The emphasis is on symbols with concrete referents. This material, which is at a very low level of abstraction, may be thought of as the elements from which more complex and abstract forms of knowledge are built.

1.11 KNOWLEDGE OF TERMINOLOGY

Knowledge of the referents for specific symbols (verbal and non-verbal). This may include knowledge of the most generally accepted symbol referent, knowledge of the variety of symbols which may be used for a single referent, or knowledge of the referent most appropriate to a given use of a symbol.

*To define technical terms by giving their attributes, properties, or relations.

*Familiarity with a large number of words in their common range of meanings.

1.12 KNOWLEDGE OF SPECIFIC FACTS

Knowledge of dates, events, persons, places, etc. This may include very precise and specific information such as the specific date or exact magnitude of a phenomenon. It may also include approximate or relative information such as an approximate time period or the general order of magnitude of a phenomenon.

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*Illustrative educational objectives selected from the literature.

*The recall of major facts about particular cultures.

*The possession of a minimum knowledge about the organisms studied in the laboratory.

1.20 KNOWLEDGE OF WAYS AND MEANS OF DEALING WITH SPECIFICS

Knowledge of the ways of organizing, studying, judging, and criticizing. This includes the methods of inquiry, the chronological sequences, and the standards of judgment within a field as well as the patterns or organization through which the areas of the fields themselves are determined and internally organized. This knowledge is at an intermediate level of abstraction between specific knowledge on the one hand and knowledge of universals on the other. It does not so much demand the activity of the student in using the materials as it does a more passive awareness of their nature.

1.21 KNOWLEDGE OF CONVENTIONS

Knowledge of characteristic ways of treating and presenting ideas and phenomena. For purposes of communication and consistency, workers in a field employ usages, styles, practices, and forms which best suit their purposes and/or which appear to suit best the phenomena with which they deal. It should be recognized that although these forms and conventions are likely to be set up on arbitrary, accidental, or authoritative bases, they are retained because of the general agreement or concurrence of individuals concerned with the subject, phenomena, or problem.

*Familiarity with the forms and conventions of the major types of works, e.g., verse, plays, scientific papers, etc.

*To make pupils conscious of correct form and usage in speech and writing.

1.22 KNOWLEDGE OF TRENDS AND SEQUENCES

Knowledge of the processes, directions, and movements of phenomena with respect to time.

*Understanding of the continuity and development of American culture as exemplified in American life.

*Knowledge of the basic trends underlying the development of public assistance programs.

1.23 KNOWLEDGE OF CLASSIFICATIONS AND CATEGORIES

Knowledge of the classes, sets, divisions, and arrangements which are regarded as fundamental for a given subject field, purpose, argument, or problem.

*To recognize the area encompassed by various kinds of problems or materials.

*Becoming familiar with a range of types of literature.

1.24 KNOWLEDGE OF CRITERIA

Knowledge of the criteria by which facts, principles, opinions, and conduct are tested or judged.

*Familiarity with criteria for judgment appropriate to the type of work and the purpose for which it is read.

*Knowledge of criteria for the evaluation of recreational activities.

1.25 KNOWLEDGE OF METHODOLOGY

Knowledge of the methods of inquiry, techniques, and procedures employed in a particular subject field as well as those employed in investigating particular problems and phenomena. The emphasis here is on the individual's knowledge of the method rather than his ability to use the method.

*Knowledge of scientific methods for evaluating health concepts.

*The student shall know the methods of attack relevant to the kinds of problems of concern to the social sciences.

1.30 KNOWLEDGE OF THE UNIVERSALS AND ABSTRACTION IN A FIELD

Knowledge of the major schemes and patterns by which phenomena and ideas are organized. These are the large structures, theories, and generalizations which dominate a subject field or which are quite generally used in studying phenomena or solving problems. These are at the highest levels of abstraction and complexity.

1.31 KNOWLEDGE OF PRINCIPLES AND GENERALIZATIONS

Knowledge of particular abstractions which summarize observations of phenomena. These are the abstractions which are of value in explaining, describing, predicting, or in determining the most appropriate and relevant action or direction to be taken.

*Knowledge of the important principles by which our experience with biological phenomena is summarized.

*The recall of major generalizations about particular cultures.

1.32 KNOWLEDGE OF THEORIES AND STRUCTURES

Knowledge of the body of principles and generalizaitons together with their interrelations which present a clear, rounded, and systematic view of a complex phenomenon, problem, or field. These are the most abstract formulations, and they can be used to show the interrelation and organization of a great range of specifics.

*The recall of major theories about particular cultures.

*Knowledge of a relatively complete formulation of the theory of evolution.

INTELLECTUAL ABILITIES AND SKILLS

Abilities and skills refer to organized modes of operation and generalized techniques for dealing with materials and problems. The materials and problems may be of such a nature that little or no specialized and technical information is required. Such information as is required can be assumed to be part of the individual's general fund of knowledge. Other problems may require specialized and technical information at a rather high level such that specific knowledge and skill in dealing with the problem and the materials are required. The abilities and skills objectives emphasize the mental processes of organizing and reorganizing material to achieve a particular purpose. The materials may be given or remembered.

2.00 COMPREHENSION

This represents the lowest level of understanding. It refers to a type of understanding or apprehension such that the individual knows what is being communicated and can make use of the material or idea being communicated without necessarily relating it to other material or seeing its fullest implications.

2.10 TRANSLATION

Comprehension as evidenced by the care and accuracy with which the communication is paraphrased or rendered from one language or form of communication to another. Translation is judged on the basis of faithfulness and accuracy, that is, on the extent to which the material in the original communication is preserved although the form of the communication has been altered.

*The ability to understand non-literal statements (metaphor, symbolism, irony, exaggeration).

*Skill in translating mathematical verbal material into symbolic statements and vice versa.

2.20 INTERPRETATION

The explanation or summarization of a communication. Whereas translation involves an objective part-for-part rendering of a communication, interpretation involves a reordering, rearrangement, or a new view of the material.

*The ability to grasp the thought of the work as a whole at any desired level of generality.

*The ability ot interpret various types of social data.

2.30 EXTRAPOLATION

The extension of trends or tendencies beyond the given data to determine implications, consequences, corollaries, effects, etc., which are in accordance with the conditions described in the original communication.

*The ability to deal with the conclusions of a work in terms of the immediate inference made from the explicit statements.

*Skill in predicting continuation of trends.

3.00 APPLICATION

The use of abstractions in particular and concrete situations. The abstractions may be in the form of general ideas, rules of procedures, or generalized methods. The abstractions may also be technical principles, ideas, and theories which must be remembered and applied.

*Application to the phenomena discussed in one paper of the scientific terms or concepts used in other papers.

*The ability to predict the probable effect of a change in a factor on a biological situation previously at equilibrium.

4.0 ANALYSIS

The breakdown of a communication into its constituent elements or parts such that the relative hierarchy of ideas is made clear and/or the relations between the ideas expressed are made explicit. Such analyses are intended to clarify the communication, to indicate how the communication is organized, and the way in which it manages to convey its effects, as well as its basis and arrangements.

4.10 ANALYSIS OF ELEMENTS

Identification of the elements included in a communication.

*The ability to recognize unstated assumptions.

*Skill in distinguishing facts from hypotheses.

4.20 ANALYSIS OF RELATIONSHIPS

The connections and interactions between elements and parts of a communication.

*Ability to check the consistency of hypotheses with given information and assumptions.

*Skill in comprehending the interrelationships among the ideas in a passage.

4.30 ANALYSIS OF ORGANIZATIONAL PRINCIPLES

The organization, systematic arrangement, and structure which hold the communication together. This includes the "explicit" as well as the "implicit" structure. It includes the bases, necessary arrangement, and the mechanics which make the communication a unit.

*The ability to recognize form and pattern in literary or artistic works as a means of understanding their meaning.

*Ability to recognize the general techniques used in persuasive materials, such as advertising, propaganda, etc.

5.0 SYNTHESIS

The putting together of elements and parts so as to form a whole. This involves the process of working with pieces, parts, elements, etc., and arranging and combining them in such a way as to constitute a pattern or structure not clearly there before.

5.10 PRODUCTION OF A UNIQUE COMMUNICATION

The development of a communication in which the writer or speaker attempts to convey ideas, feelings, and/or experiences to others.

*Skill in writing, using an excellent organization of ideas and statements.

*Ability to tell a personal experience effectively.

5.20 PRODUCTION OF A PLAN, OR PROPOSED SET OF OPERATIONS

The development of a plan of work or the proposal of a plan of operations. The plan should satisfy requirements of the task which may be given to the student or which he may develop for himself.

*Ability to propose ways of testing hypotheses.

*Ability to plan a unit of instruction for a particular teaching situation.

5.30 DERIVATION OF A SET OF ABSTRACT RELATIONS

The development of a set of abstract relations either to classify or explain particular data or phenomena, or the deduction of propositions and relations from a set of basic propositions or symbolic representations.

*Ability to formulate appropriate hypotheses based upon an analysis of factors involved, and to modify such hypotheses in the light of new factors and considerations.

*Ability to make mathematical discoveries and generalizations.

6.0 EVALUATION

Judgments about the value of material and methods for given purposes. Quantitative and qualitative judgments about the extent to which material and methods satisfy criteria. Use of a standard of appraisal. The criteria may be those determined by the student or those which are given to him.

6.10 JUDGMENTS IN TERMS OF INTERNAL EVIDENCE

Evaluation of the accuracy of a communication from such evidence as logical accuracy, consistency, and other internal criteria.

*Judging by internal standards, the ability to assess general probability of accuracy in reporting facts from the care given to exactness of statement, documentation, proof, etc.

*The ability to indicate logical fallacies in arguments.

6.20 JUDGMENTS IN TERMS OF EXTERNAL CRITERIA

Evaluation of material with reference to selected or remembered criteria.

*The comparison of major theories, generalizations, and facts about particular cultures.

*Judging by external standards, the ability to compare a work with the highest known standards in its field -- especially with other words or recognized excellence.

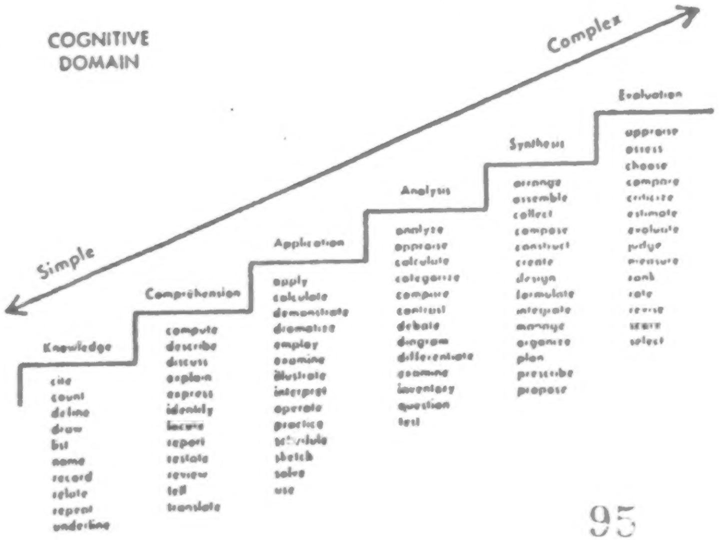
Structure of a Modified Taxonomy of Educational Objectives

MAJOR CATEGORIES	SUB-CATEGORIES
1.0 KNOWLEDGE: (Development of ability to recall appropriate information, with or without comprehension)	The learner will verbally recall: KNOWLEDGE OF SPECIFICS 1.11 Knowledge of terms 1.12 Knowledge of specific facts KNOWLEDGE OF WAYS & MEANS OF DEALING WITH SPECIFICS 1.21 Knowledge of conventions 1.22 Knowledge of trends & sequences 1.23 Knowledge of classifications & categories 1.24 Knowledge of criteria 1.25 Knowledge of methodology KNOWLEDGE OF UNIVERSALS & ABSTRACTIONS IN A FIELD 1.31 Knowledge of principles & generalizations 1.32 Knowledge of theories and structures
2.0 COMPREHENSION: (Degree to which one should be able to manipulate meaningfully Knowledge elements)	The learner will give evidence of comprehension through: 2.1 Translation 2.2 Interpretation 2.3 Extrapolation beyond data
3.0 APPLICATION: (Development of complex functional behaviors)	The learner will perform complex tasks in Application situations.
4.0 ANALYSIS: (Development of ability to identify relevant knowledge components in Application situations)	The learner will identify: 4.1 Elements 4.2 Relationships 4.3 Organizational principles relevant to specified application behavior
5.0 SYNTHESIS: (Development of ability to combine knowledge elements in fabricating appropriate Application behaviors)	The learner will combine appropriate knowledge elements into the: 5.1 Production of a unique communication 5.2 Production of a plan or proposed set of operations 5.3 Derivation of a set of abstract relations
6.0 EVALUATION: (Development of ability to appraise the appropriateness of a proposed or applied Application behavior)	The learner will appraise a communication or problem solution with: 6.1 Judgments in terms of internal evidence 6.2 Judgments in terms of external criteria

TABLE I INSTRUMENTATION OF THE TAXONOMY OF EDUCATIONAL OBJECTIVES: COGNITIVE DOMAIN

		KEY WORDS	
Taxonomy Classification		Examples of Infinitives	Examples of Direct Objects
1.00	Knowledge		
1.10	Knowledge of Specifics		
1.11	Knowledge of Terminology	to define, to distinguish, to acquire, to identify, to recall, to recognize	vocabulary, terms, terminology, meaning(s), definitions, referents, elements
1.12	Knowledge of Specific Facts	to recall, to recognize, to acquire, to identify	facts, factual information, (sources), (names), (dates), (events), (persons), (places), (time periods), properties, examples, phenomena
1.20	Knowledge of Ways and Means of Dealing with Specifics		
1.21	Knowledge of Conventions	to recall, to identify, to recognize, to acquire	form(s), conventions, uses, usage, rules, ways, devices, symbols, representations, style(s), format(s)
1.22	Knowledge of Trends, Sequences	to recall, to recognize, to acquire, to identify	action(s), processes, movement(s), continuity, development(s), trend(s), sequence(s), causes, relationship(s), forces, influences
1.23	Knowledge of Classifications and Categories	to recall, to recognize, to acquire, to identify	area(s), type(s), feature(s), class(es), set(s), division(s), arrangement(s), classification(s), category/categories
1.24	Knowledge of Criteria	to recall, to recognize, to acquire, to identify	criteria, basics, elements
1.25	Knowledge of Methodology	to recall, to recognize, to acquire, to identify	methods, techniques, approaches, uses, procedures, treatments
1.30	Knowledge of the Universals and Abstractions in a Field		
1.31	Knowledge of Principles, Generalizations	to recall, to recognize, to acquire, to identify	principle(s), generalization(s), proposition(s), fundamentals, laws, principal elements, implication(s)
1.32	Knowledge of Theories and Structures	to recall, to recognize, to acquire, to identify	theories, bases, interrelations, structure(s), organization(s), formulation(s)
2.00	Comprehension		
2.10	Translation	to translate, to transform, to give in own words, to illustrate, to prepare, to read, to represent, to change, to rephrase, to restate	meaning(s), sample(s), definitions, abstractions, representations, words, phrases
2.20	Interpretation	to interpret, to reorder, to rearrange, to differentiate, to distinguish, to make, to draw, to explain, to demonstrate	relevancies, relationships, essentials, aspects, new view(s), qualifications, conclusions, methods, theories, abstractions
2.30	Extrapolation	to estimate, to infer, to conclude, to predict, to differentiate, to determine, to extend, to interpolate, to extrapolate, to fill in, to draw	consequences, implications, conclusions, factors, ramifications, meanings, corollaries, effects, probabilities

Taxonomy Classification	KEY WORDS	
	Examples of Infinitives	Examples of Direct Objects
3.00 Application	to apply, to generalize, to relate, to choose, to develop, to organize, to use, to employ, to transfer, to restructure, to classify	principles, laws, conclusions, effects, methods, theories, abstractions, situations, generalizations, processes, phenomena, procedures
4.00 Analysis		
4.10 Analysis of Elements	to distinguish, to detect, to identify, to classify, to discriminate, to recognize, to categorize, to deduce	elements, hypothesis/hypotheses, conclusions, assumptions, statements (of fact), statements (of intent), arguments, particulars
4.20 Analysis of Relationships	to analyze, to contrast, to compare, to distinguish, to deduce	relationships, interrelations, relevance, relevancies, themes, evidence, fallacies, arguments, cause-effect(s), consistency/consistencies, parts, ideas, assumptions
4.30 Analysis of Organizational Principles	to analyze, to distinguish, to detect, to deduce	form(s), pattern(s), purpose(s), point(s) of view(s), techniques, bias(es), structure(s), theme(s), arrangement(s), organization(s)
5.00 Synthesis		
5.10 Production of a Unique Communication	to write, to tell, to relate, to produce, to constitute, to transmit, to originate, to modify, to document	structure(s), pattern(s), product(s), performance(s), design(s), work(s), communications, effort(s), specifics, composition(s)
5.20 Production of a Plan, or Proposed Set of Operations	to propose, to plan, to produce, to design, to modify, to specify	plan(s), objectives, specification(s), schematic(s), operations, way(s), solution(s), means
5.30 Derivation of a Set of Abstract Relations	to produce, to derive, to develop, to combine, to organize, to synthesize, to classify, to deduce, to develop, to formulate, to modify	phenomena, taxonomies, concept(s), scheme(s), theories, relationships, abstractions, generalizations, hypothesis/hypotheses, perceptions, ways, discoveries
6.00 Evaluation		
6.10 Judgments in Terms of Internal Evidence	to judge, to argue, to validate, to assess, to decide	accuracy/accuracies, consistency/consistencies, fallacies, reliability, flaws, errors, precision, exactness
6.20 Judgments in Terms of External Criteria	to judge, to argue, to consider, to compare, to contrast, to standardize, to appraise	ends, means, efficiency, economy/economics, utility, alternatives, courses of action, standards, theories, generalizations


COGNITIVE DOMAIN
Complex
Simple
Knowledge
cite
count
define
draw
list
name
record
relate
repeat
underline
Comprehension
compute
describe
discuss
explain
express
identify
locate
report
restate
review
tell
translate
Application
apply
calculate
demonstrate
dramatize
employ
examine
illustrate
interpret
operate
practice
schedule
sketch
solve
use
Analysis
analyze
appraise
calculate
categorize
compare
contrast
debate
diagram
differentiate
examine
inventory
question
test
Synthesis
arrange
assemble
collect
compose
construct
create
design
formulate
integrate
manage
organize
plan
prescribe
propose
Evaluation
appraise
assess
choose
compare
criticize
estimate
evaluate
judge
measure
rank
rate
revise
score
select

THE CLASSIFICATION OF EDUCATIONAL OBJECTIVES
Psychomotor Domain*

1.0 *Perception* – the essential first step; the process of becoming aware of objects, qualities, or relations by way of sense organs

  1.1 *Sensor stimulation* – the impingement of a stimulus upon one or more of the sense organs

    1.1.1 Auditory

    1.1.2 Visual

    1.1.3 Tactile

    1.1.4 Smell

    1.1.5 Kinesthetic

  1.2 *Cue selection* – identification of the cue or cues and associating them with the task to be performed

  1.3 *Translation* – relating of perception to action in performing a motor act: the mental process of determining the meaning of the cues received for action

2.0 *Set* – a preparatory adjustment or readiness for a particular kind of action or experience

  2.1 *Mental set* – readiness in the sense of having made the anatomical adjustments necessary for a motor act to be performed

  2.2 *Emotional set* – readiness in terms of attitudes favorable to the motor act's taking place. Willingness to respond is implied.

3.0 *Guided response* – an early step in the development of skill. Emphasis is upon the abilities which are components of the more complex skill.

  3.1 *Imitation* – the execution of an act as a direct response to the perception of another person performing the act

  3.2 *Trial and error* – trying various responses, usually with some rationale for each response, until an appropriate response is achieved

4.0 *Mechanism* – the habituation of a learned response. At this level, the learner has achieved a certain confidence and degree of skill in performance of the act.

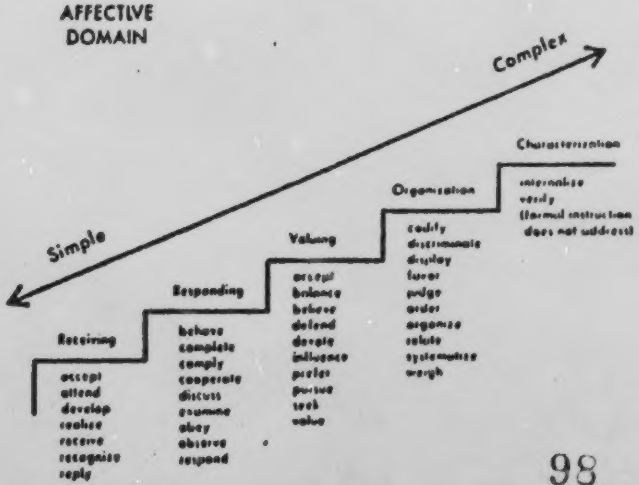
5.0 *Complex overt response* – the individual can perform a motor act that is considered complex because of the movement pattern required; a high degree of skill has been attained; the act can be carried out smoothly and efficiently.

  5.1 *Resolution of uncertainty* – the act is performed without hesitation; the individual knows the sequence required and so proceeds with confidence.

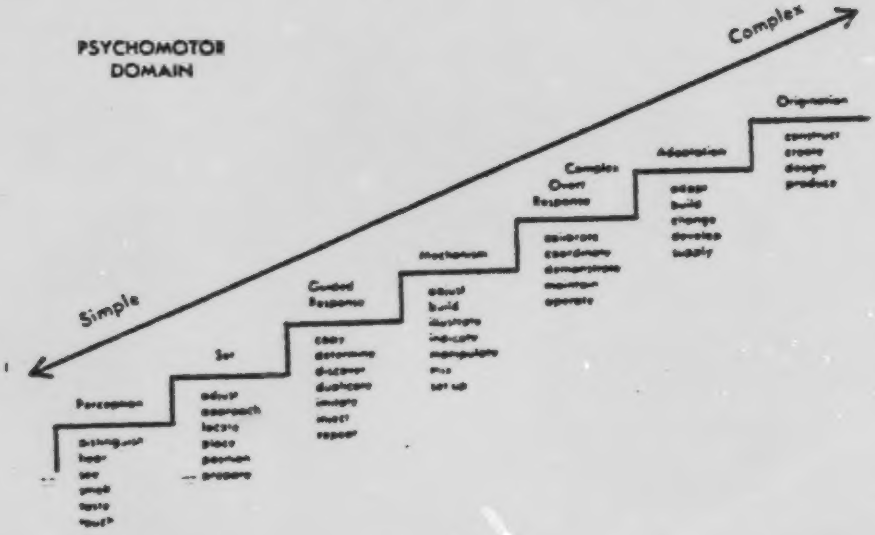
  5.2 *Automatic performance* – the individual can perform a finely coordinated skill with a great deal of ease and muscle control.

TABLE I. [illegible]UMENTATION OF THE TAXONOMY OF [illegible]UCATIONAL OBJECTIVES: AFFECTIVE DOMAIN

Taxonomy Classification		KEY WORDS Examples of Infinitives	Examples of Direct Objects
1.0	Receiving		
1.1	Awareness	to differentiate, to separate, to set apart, to share	sights, sounds, events, designs, arrangements
1.2	Willingness to Receive	to accumulate, to select, to combine, to accept	models, examples, shapes, sizes, meters, cadences
1.3	Controlled or Selected Attention	to select, to posturally respond to, to listen (for), to control	alternatives, answers, rhythms, nuances
2.0	Responding		
2.1	Acquiescence in Responding	to comply (with), to follow, to commend, to approve	directions, instructions, laws, policies, demonstrations
2.2	Willingness to Respond	to volunteer, to discuss, to practice, to play	instruments, games, dramatic works, charades, burlesques
2.3	Satisfaction in Response	to applaud, to acclaim, to spend leisure time in, to augment	speeches, plays, presentations, writings
3.0	Valuing		
3.1	Acceptance of a Value	to increase measured proficiency in, to increase numbers of, to relinquish, to specify	group membership(s), artistic production(s), musical productions, personal friendships
3.2	Preference for a Value	to assist, to subsidize, to help, to support	artists, projects, viewpoints, arguments
3.3	Commitment	to deny, to protest, to debate, to argue	deceptions, irrelevancies, abdications, irrationalities
4.0	Organization		
4.1	Conceptualization of a Value	to discuss, to theorize (on), to abstract, to compare	parameters, codes, standards, goals
4.2	Organization of A Value System	to balance, to organize, to define, to formulate	systems, approaches, criteria, limits
5.0	Characterization by Value or Value Complex		
5.1	Generalized Set	to revise, to change, to complete, to require	plans, behavior, methods, effort(s)
5.2	Characterization	to be rated high by peers in, to be rated high by superiors in, to be rated high by subordinates in	humanitarianism, ethics, integrity, maturity
		and	
		to avoid, to manage, to resolve, to resist	extravagance(s), excesses, conflicts, exorbitancy/exorbitancies


AFFECTIVE DOMAIN
Complex
Simple
Receiving
accept
attend
develop
realize
receive
recognize
reply
Responding
behave
complete
comply
cooperate
discuss
examine
obey
observe
respond
Valuing
accept
balance
believe
defend
devote
influence
prefer
pursue
seek
value
Organization
codify
discriminate
display
favor
judge
order
organize
relate
systematize
weigh
Characterization
internalize
verify
(formal instruction does not address)

PSYCHOMOTOR DOMAIN


Complex
Simple
Perception
distinguish
hear
see
smell
taste
touch
Set
adjust
approach
locate
place
position
prepare
Guided Response
copy
determine
discover
duplicate
imitate
inject
repeat
Mechanism
adjust
build
illustrate
indicate
manipulate
mix
set up
Complex Overt Response
calibrate
coordinate
demonstrate
maintain
operate
Adaptation
adapt
build
change
develop
supply
Origination
construct
create
design
produce

EXERCISE A

Laboratory Procedures

Content:

A. Media
  1. Primary Plating Media
  2. Identification and Speciation Media

B. Stains/Slide Preparations
  1. Direct Mounts
  2. KOH Mount (10-20%)
  3. Lactophenol Cotton Blue
  4. India Ink
  5. Periodic Acid Schiff's Stain
  6. Acid Fast Stain (Hank's)
  7. Gram Stain
  8. Permanent Mounts
  9. Cellophane Tape Cover Glass Method

C. Special Techniques
  1. Petri Dish Cultures
  2. Test Tube Cultures
  3. Slide Culture Technique
  4. Wood's Lamp Examination

D. Specimens
  1. Sources
    a. Skin Scrapings
    b. Nail Scrapings/Clippings
    c. Hair
    d. Pus or Exudates
    e. Spinal Fluid
    f. Sputum
    g. Bone Marrow and Blood
    h. Biopsy and Autopsy Specimens
  2. Processing - (Safety & Methods)

E. Quality Control

Objectives: Be able to:

Recall

- State the role of specific ingredients in at least 3 primary media used for the isolation of fungi
- Indicate the use of the following media: corn meal, chlamydospore agar, potato dextrose
- Indicate the use of each of the stains/slide preparations listed
- Distinguish between the Hank's Acid Fast Stain and the Kin youn Acid Fast Stain
- List the steps in preparing a slide culture
- State the proper technique for collection of specimen sources listed.

- Indicate appropriate primary plating media and incubation conditions for each specimen listed above

- Given a method and a source of specimen, analyze the appropriateness of the method used

III. Mycoses - (Pathology, Epidemiology, Specimens, Etiological Agents, Identification)

Content:

A. Superficial Mycoses
   1. Piedraia hortai
   2. Trichosporon beigelli (cutaneum)
   3. Pityrosporum (Malassezia) furfur
   4. Cladosporium Werneckii

B. Cutaneous Mycoses (Dermatomycoses)
   1. Microsporum ssp.
   2. Trichophyton ssp.
   3. Epidermophyton floccosum

C. Subcutaneous Mycoses
   1. Petriellidium boydii
   2. Actinomyces ssp.
   3. Nocardia ssp.
   4. Streptromyces ssp.
   5. Sporothrix schenchii
   6. Cladosporium carrionii
   7. Phialophora ssp.

D. Cutaneous and/or Systemic Mycoses
   1. Candida ssp.
   2. Crytococcus ssp.
   3. Torulopsis ssp.
   4. Geotrichum candidum
   5. Actinomyces ssp.
   6. Nocardia ssp.

E. Systemic Mycoses
   1. Coccidioides immitis
   2. Histoplasma capsulatum
   3. Blastomyces dermatiditis
   4. Paracoccidioides braziliensis

F. Miscellaneous Mycoses
   1. Rhinosporidium seeberi
   2. Mucor sp.
   3. Rhizopus sp.
   4. Absidia sp.
   5. Asperigillus sp.

Objectives: Be able to:

- Classify a given fungus into the appropriate type of mycoses

- Describe the differences among superficial, cutaneous,

TABLE OF SPECIFICATION

Testing is almost always a matter of sampling since we usually cannot ask all possible questions that we expect students to know as a result of our instruction. Because of time available for evaluation, we can include only a fraction of the things we want them to know or applications of principles we have covered. It is the test constructor's responsibility to determine a representative sample which adequately reflects the entire content which the test is suppose to cover. One way to provide greater assurance that a test is a representative sample of the desired behavior is to construct a table of specification or a test blueprint as it is sometimes called.

The table of specification is essentially a two-way dimensional table of the items which will constitute the test to be written. This table usually lists the units (course) objectives across the top and the content (subject) down the left hand side. The intersecting cells of this two-way grid contains the proportions of the test devoted to each object and subject matter topic.

In addition, the table of specification should contain percentages of the number of items that reflect the relative emphasis given each objective in the individual situation.

In assigning relative weights to each cell, a number of factors should be considered:

How important is each area in the total learning experience?

How much time was devoted to each area during instruction?

Which outcomes have the greatest retention and transfer value?

What relative importance do subject experts assign to each area?

Other similar criteria can be considered but in the final analysis the weights assigned should faithfully reflect the emphasis given during instruction.

One of the basic purposes of a grid is to increase the relavancy and content validity of the test by providing the evaluator greater assurance that the written exam will measure the learning outcomes and course content in a balanced manner. The blueprint insures that the test is "balanced", that is, that no important outcomes or elements of content have been overlooked in its construction. An evaluator can build a test which has a high content validity by:

1. Identifying the subject matter topics and behavioral outcomes covered in instruction,
2. Building table of specifications which represents the relative importance of each area, and
3. Constructing times which closely fits the table of specifications.

By ensuring that only those objectives acutally pursued in instruction are measured, that no important objective is overlooked and that each objective receives an appropriate emphasis in the test, a table of specification will assist the evaluator in satisfying the most important criterion of the test-content validity.

Ideally a table could be constructed before the course is taught to assist in course preparation and helping the instructor to be effective and efficient by keeping him from "straying off" the instructional track.

Certain bits of advice can be offered for the construction of test blueprints. First of all, it is probably better to begin with a more detailed specification of content that will evantually be used. As you draw up the table in its rough form, you can see where categories can be combined with no great loss of precision. Second, the initial blueprint may not exactly correspond with the completed test. Even though you have specified a certain number of items for a given cell, you may find it impossible to produce all the items you have specified. In such a case, you have no alternative but to make changes in your design. Last, the weights assigned by allocating certain number of items to certain outcomes may not give a completely accurate picture. Such a procedure assumes independence among items. If items are correlated, the outcomes measured by such items receive increased weights. This is a technical matter, however, which need not be of great concern to the evaluator.

In summary, the use of a table of specification in test development will help ensure:

1. That only those objectives actually pursued in the instruction will be measured,
2. That each objective will receive the appropriate relative importance/emphasis in the test, and
3. That by using a sufficient number of subdivisions based on content and behavior, no important objective will be overlooked or misrepresented.

MICROBIOLOGY

TABLE OF SPECIFICATIONS

Subcommittee:______________________

MLT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content	55 items	35 items	10 items	100 item
Total	55%	35%	10%	100%

rev. 1981

Criterion-Referenced
Examinations
ASMT, 1979

ITEM EDITING GUIDELINES

1. Each examination item must measure the material within a specific objective. The item is referenced to the objective. The problem, answer, and distractors will come from information within the objective.

2. Each examination item must measure behavior which is identifiable by taxonomy level as defined in"Taxonomy of Educational Objectives," B.S. Bloom, Ed.

3. The stem should clearly formulate a single problem and should be expressed as a complete thought so that it is necessary to reread it in conjunction with each response.

4. Include as much of the information as possible within the stem, to eliminate redundant phrases in the responses.

5. Keep unnecessary information out of the stem, insuring only that the problem is clear and specific.

6. Avoid the use of negative stems or questions which call for exceptions. When it is necessary to use them, emphasize the negative aspect ("Which of the following is NOT...?").

7. An alternative to a negative stem in the "multiple multiple" format in which there is more than one correct answer. In this format, a single response will serve to identify more than one right answer:

   Which of the following is...?

   a. 1 and 3   1. ...
   b. 2 and 4   2. ...
   c. 2, 3, and 4   3. ...
   d. 1, 3, and 4   4. ...
   e. 1, 2, 3 and 4

8. Formulate problems using novel material when measuring ability to apply principles.

9. Responses should be brief.

10. Responses should all be grammatically consistent with the stem.

11. All distractors should be plausible.

12. Responses should be arranged in some logical order; by relative length, consecutive concept (myeloblast, promyelocyte, ...), or numerical order.

13. Irregularities in grammar, length, and order often serve as clues to the right answer.

14. The use of "all the above" or "none of the above" is often a crutch for when an additional response is needed. "All of the above" is usually obvious. "None of the above" creates ambiguity about the right answer.

15. Have a system for rating the relative "difficulty" of each response.

16. Have a separate individual review each item for possible flaws.

EXECISE B

Criterion-Referenced
Examinations
ASMT, 1981

ITEM CORRECTION AND CLASSIFICATION

Examine the following test items. Using the Item Editing Guidelines, find areas of weakness in each item and rewrite it with your improvement. Then classify the item by taxonomy level.

1. Certain species of Hemophilus require Factor X only. Therefore, they will grow on:

   a. ~~5%~~ sheep blood agar
   b. ~~5%~~ sheep blood agar ~~streak~~ with Staphylococci
   c. BHI agar with staphylococci
   d. ~~a and b~~
   e. ~~b and c~~
   f. ~~all of the above~~

Corrections: Taxonomy Level: ______

2. All species of the genus Neisseria ~~are gram negative diplococci and~~ have the capability to oxidize:

   a. ~~glucose~~
   b. tetra-methyl-p-phenylene diamine-HCl
   c. poly-B-hydroxybutyric acid
   d. para-dimethyl aminobenzaldehyde

Correction: Taxonomy Level: ______

3. Which of the following organisms might be considered to be pathogen if found in the URT? →

   a. alpha strep
   b. Corynebacterium diphtheriae ↓
   c. Micrococcus
   d. Neisseria sp.

Corrections: Taxonomy Level: ______

4. A pure culture of ~~many~~ alpha hemolytic transparent colonies were isolated from a sputum culture. A gram stain shows ~~many~~ gram positive cocci in pairs. What should be the next step? in order to identify the organism?

   a. bacitracin
   b. coagulase
   c. bile solubility
   d. bile esculin

Corrections: Taxonomy Level: ______

5. Enterococci are:

   a. ~~catalase negative~~, esculin positive and grow in 6.5% NaCl
   b. ~~catalase negative~~, hydrolyze hippurate and grows in 6.5% NaCl
   c. ~~catalase negative~~, bile soluble and positive for esculin
   cannot grow in 6.5% NaCl.

Confusing order

SETTING STANDARDS OF COMPETENCE

THE MINIMUM PASS LEVEL

I. THEORETICAL CONSIDERATIONS

Exploring alternative methods by which a faculty can evaluate student competence as precisely and as validly as possible, one finds that there are basically two ways of assessing an individual's performance on any achievement test: (A) by judging his performance in terms of its relation to others in his group; and (B) by judging his performance in terms of predetermined criteria.

(A) "Grading on the curve," i.e., judging by relative standards, is widely used throughout the educational system, including such standardized tests as MCAT and National Boards. However, even under optimal circumstances the method is subject to the following deficiencies:

1. Standards are set in terms of what is rather than in terms of what ought to be.

2. An individual will "look good" either if he personally achieves a great deal, or if he is a member of a group most of whom achieve very little. It follows that some students who are judged to be competent in one year would not necessarily be so judged if they belonged to the group a year earlier or a year later.

3. Changes in the quality of an individual's or a group's performance over time cannot be documented accurately since performance on each test is measured only in relation to that test itself, leaving inadequate basis for comparison with performance on other tests,

These deficiencies are especially serious if the reference group is a single class, in a single year, in a single school, from a highly select population (such as nuclear physicists or medical students). In this situation the group itself becomes the arbiter of the standards in terms of which it is judged, and group enforced pressures can be as serious in schools as in factories.

(B) Judging the individual's performance in terms of predetermined criteria of adequacy, which are independent of the performance of the particular group of which he is a member, may have the following drawbacks:

1. Responsible faculty members do have different standards.

2. Even if agreement on general standards can be reached, there remains the difficulty of obtaining specific agreement about what level of performance on a particular test is necessary to meet that generally accepted standard.

3. Revisions in standards may be required in order to bring them into accord with the reality of a particular learning situation. (For example, it may be desirable, but unrealistic to require that all medical students develop facility with clinical research techniques if that goal is assigned a lower priority than clinical competence per se, and if time to accomplish both is inadequate.)

Despite these difficulties, the method of basing judgements upon predetermined criteria is uniquely suited to the evaluation of individuals who come from a highly select population and who belong to a single community of scholars who share a common concept, however vaguely defined, of what constitutes acceptable professional performance. It has the specific advantage that the faculty does, in fact, establish the standards for student performance. The application of this method to examinations requires that the standard be an explicit judgment about the character of individual questions and problems, not merely an overall estimate of what a student "ought to do on tests like this."

II. PROCEDURE

The Minimum Pass Level system provides the faculty with a method of establishing predetermined criteria of acceptable examination performance. This system assumes that students may be classified into three groups--clearly competent, minimally competent, and clearly incompetent--based upon their examination performance, and that the faculty can define these levels of competence in terms of how students should respond to examination items.

The MINIMUM PASS LEVEL (MPL) for an examination is the minimum score a student must achieve in order to be certified as proficient in a course or program of studies. The MPL is set before an examination is administered when the faculty specifies how students who are MINIMALLY COMPETENT according to faculty standards should respond to the items appearing on that examination. The methods of determining the MPL for multiple-choice , examinations are discussed below.

Determining the MPL for Multiple-Choice Examinations

The faculty author or reviewer of a multiple-choice item assigns a difficulty code to each of the item's answers using the following coding scheme:

FIRST: Read the item carefully. Using the line provided for difficulty codes, place an "X" in the space corresponding to the ONE BEST response alternative. In Example 1 below, response 4 is the best, i.e., correct response. ("X" has a code value of "2".)

SECOND: Classify each of the remaining answers according to the DEGREE OF DIFFICULTY they should present to the MINIMALLY COMPETENT STUDENT. The minimally competent student is the student who has just sufficient understanding of the essential facts and concepts to pass the course or to be certified as proficient in a field of study. Assign to each response (other than the best response already marked "X") a value ranging from 0 to 2 according to the following criteria:

0. a "0" is assigned to those answers which the minimally competent student should be expected to recognize as incorrect and therefore should be able to avoid. In example 1, responses 1, 2 and 6 are judged to be such by the item's author.

2. a "2" is assigned to those answers which the minimally competent student should NOT be expected to recognize as incorrect. The minimally competent student would not be able to distinguish between this answer and the correct one. Response 5 below has been indicated in this way.

1. a "1" is assigned to those answers which the minimally competent student may or may not be able to eliminate. Such a response is not clearly incorrect, but neither is it so difficult that minimally competent students should never be expected to perceive it as incorrect. Response 3 below has been classified in this way.

Note: Decimals are also acceptable. For example, if an answer deserves more than a "1" but less than a "2", a value between these such as "1.5" may be assigned.

Example 1

The population of the United States in 1970 was approximately

1- 100,000,000.
2- 105,000,000.
3- 190,000,000.
4- 200,000,000.
5- 205,000,000.
6- 210,000,000.

Difficulty Codes:

1: 0 2: 0 3: 1 4: X 5: 2 6: 0 7: ___ 8: ___ 9: ___

In considering the difficulty of an individual item it is important to note that a question about a very sophisticated concept may require only the most elementary understanding if the wrong answers are so implausible as to require very little discrimination in rejecting them, as in Example 2; alternatively, the range of choice given in answers to the identical question may require very fine discriminations as in Example 1.

Example 2

The population of the United States in 1970 was approximately

1- 2,000.
2- 200,000.
3- 2,000,000.
4- 20,000,000.
5- 200,000,000.

Difficulty Codes:

1: 0 2: 0 3: 0 4: 0 5: X 6: ___ 7: ___ 8: ___ 9: ___

The MINIMUM PASS INDEX (MPI) for a multiple-choice item is a number which describes the difficulty of that item in terms of the probability that a minimally competent student would answer it correctly. The MPI is computed by dividing 2 by the sum of the item's difficulty codes. In Example 1 above, the difficulty codes add up to 5, so the MPI for this item is 2/5 or .40. This MPI means that the minimally competent student has a 40% chance of responding correctly to this item, once he has eliminated those responses which his minimal competence enables him to identify as incorrect.

The MINIMUM PASS LEVEL (MPL) for a multiple-choice examination is the sum of the MPI's for the items. (The MPL can be expressed in percent form also, by dividing the sum of the MPI's by the number of items.) In statistical terms, the MPL is the most likely score a minimally competent student will achieve. In terms of promotion policy, the MPL is the lowest score a student may achieve to

CALCULATION OF THE MINIMUM PASS LEVEL FOR THE EXAMINATION

The Minimum Pass Level (MPL) for the criterion reference examination is the sum of the minimum pass indices (MPIs) rounded up to the nearest whole number.

SCORING THE EXAM

The examination scores are created by awarding one point for a correct response and zero points for an incorrect response. An incorrect response does not receive credit even if the option selected was categorized as an acceptable response representing a sufficient partial knowledge base.

High MPL = easier questions or too high standards.

Low MPL = relatively difficult and thus have lowered standard to compensate for difficulty

EXERCISE: Peer Review & Assigning MPIs

Level	Grid Reference	Item	MPI
MLT	A-1 (T1) Recall	1. The catalyst in the Gas Pak anaerobic jar contains: a. carbon dioxide 0 b. hydrogen 0 c. hydrogen and carbon dioxide 1 X d. palladium 2	2/3 .66
MLT	A-2 (T1) Recall	2. The indistinct zone of partial lysis of red cells surrounding a colony is the describes: X a. alpha hemolysis b. beta hemolysis c. gamma hemolysis d. alpha-prime hemolysis	
M	B-3 (T2) Interpretation	3. What color of colonies develops when lactose negative organisms such as Salmonella are inoculated onto MacConkey's agar? 0 a. black X b. colorless 0 c. green 0 d. red	3/4 .66
MLT	C-2 (T2) Interpretation	4. An enteric gram negative bacillus which produces colorless colonies on MacConkey and an acid slant and butt on TSI has NOT fermented: a. dextrose b. lactose c. maltose X d. sucrose	
MLT	F-5 (T3) Problem Solving	5. The following organism is a gram-positive, diphtheroid-like rod, that is catalase positive, beta-hemolytic on sheep blood agar and motile at room temperature: 0 a. Bacillus subtilis 1 0 b. Erysipelothrix sp. 1 0 c. Corynebacterium sp. 1 X d. Listeria monocytogenes 2	2/5 .4

Level	Grid Reference	Item	MPI
MLT	H-4 (T-3) Problem	6. From the following sets of media, select the one best combination that could be appropriate for the primary isolation of organisms from an eye source: a. MacConkey's agar, Sheep blood agar, Thioglycollate broth b. Mannitol Salt agar, Sheep blood agar, MacConkey's agar X c. Sheep blood agar, Chocolate agar, Thioglycollate broth d. Thayer-Martin medium, Thioglycollate broth, Sheep blood agar	

Item	1	2	3	4	MPI
1	0	0	1	X	.66
2					
3	0	X	0	1	.66
4					
5	1	1	1	X	.40
6					
				MPL=	1.72

B3

MINUTES

Monday, June 15, 1981
CMDNJ -- Newark, NJ

In attendance: Judith Allen, Diane Armington, Madeline Bonadies, John C. Davis, Anna Gargantiel, Heidi McGraw, Rennie Miller, Suzanne Roth, Kuldip Sandhu, Jeanette Sanducci, Les Stutzman, Hannah Zane, Madeline Ducate

Absent: Elaine Keohane, Robert DelGuidice, Susan Mikorski, Bruce Storm, Mary Wethington

The third meeting of the MLT/MT Microbiology Examination Committee was held on Monday, June 15, 1981, at Mercer County Community College from 9 am until 3:30 pm. with M. Ducate presiding.

At 9 am the committee was instructed in the procedure to follow for this all-day peer-review session. M. Ducate briefly discussed the validation process that was to be undertaken during the day as outlined in the Attachment. The validation process included both the exam items and the MPI values as were assigned by the respective subcommittees. The committee then divided into subgroups and reviewed questions and MPIs other than their own work. M. Ducate served as an advisor and coordiator of activities as well as a hostess providing coffee, donuts and answering questions during this brain-storming session. The groups broke only for lunch and resumed their activities until about 3 pm.

A brief business meeting followed this working session.

Travel Expenses

All travel expense forms were collected from the committee members for processing by June 20, 1981. It is expected that the participants will receive their expense checks by mid-July.

Final Examination Forms

M. Ducate will be working the months of June and July to compile the examinations into forms A and B at both the MLT and MT level. Anticipated completion date is July 30, 1981.

Final Report of the Grant

H. Zane and M. Ducate will be completing the final report of the current grant by July 30, 1981. The committee will receive a copy of the final report along with the initial forms of the exams, i.e. MLT-A, MLT-B, MT-A, MT-B. The project director requests that the examinations remain confidential until the norming process that will be scheduled in Spring 1982.

Next Meeting

The committee will reconvene next spring (1982) after the norming process has occurred and the data has been statistically analyzed and reviewed by an educational consultant. At that time the committee will select the "best" questions and design the final, revised examination at each level. The MPIs will also be readjusted by committee decision at that time. It is hoped that the examination will have the opportunity to be renormed for validation as was the Clinical Hematology Examinations, before final distribution to the educational coordiators in the state of New Jersey.

Adjournment

The meeting was adjourned at 3:45 pm.

Respectfully submitted,

Madeline Ducate

Madeline Ducate

VALIDITY

VALIDITY may be defined* as the consistency with which an instrument (TEST) measures the variable or variables it was designed to measure. This definition may be divided into two parts:

firstly - consistency of measurement or reliability.

secondly - extend to which the test measures variable or variables it was designed to measure or relevance.

BOTH must be present to some extent if the instrument is to possess any validity. If one or the other is absent, there can be no validity.

RELIABILITY is the reproducibility of a set of test results or the degree to which the same results may be obtained whenever the test is given.

RELEVANCE is the degree to which the content of the test item measures the trait(s) we want to have measured.

*Educational Measurement, Don F. Blood, William C. Budd; Harper and Row, 1972.

VALIDATION BY PEER REVIEW

I. Validation issues

   A. A test or test item is valid to the extent that the scores it assigns to examinees are free from systematic errors.

   B. Closeness or relation to actual conditions and performances in the real world.

   C. Content validity vs. criterion related validity.

II. Approaches to assessing or demonstrating content validity

   A. Item generation rules

      1. Probably too involved for routine use.
      2. Value in demonstrating a logical connection between items and content.

   B. Pretest/Post test

      1. Based on the assumption that instruction is effective.

      2. Look for substantial increase in correct responses as evidence of item validity.

   C. Judgment by Content Specialists

      1. Two or more specialists judge the relevance of each item to the objective it is intended to measure.

      2. Calculate an index of interjudge agreement as the measure of item content validity.

         a. Index of Homogeneity or Item-Objective Congruence provides useful information concerning whether each item measures achievement of

            1) only its intended objective
            2) several objectives
            3) none of the objectives

         b. Interrater Agreement - how close two specialists agree that an item is a measure of a particular objective.

III. A Second Look at Validity

   A. Descriptive Validity - established by having individuals judge the degree to which a domain definition adequately limits the nature of a set of test items and, further, the degree to which the test items are congruent with the domain definition. (Popham)

   B. Functional Validity - useful if evaluator wishes to use data for more than merely describing learner performance accurately. An example would be to use the data to predict performance on a criterion-related test.

IV. Steps in Empirical Validation of Criterion Referenced Tests

A. Syntax - Do the items "read" well? Are there any unnecessary words?

B. Correctness of the answer and appropriate use of distractors.

C. Item difficulty and acceptable level of performance.

D. Sample of items - Do the items reflect the appropriate emphasis of content? Cross check with the test grid.

E. Item validity - do the items measure what they're intended to measure?

References:

Martuza, VR: Applying Norm-Referenced and Criterion Referenced Measurement in Education. Allyn and Bacon, Inc., 1977.

Popham, WJ: Educational Evaluation. Prentice-Hall, 1975.

CHECK LIST FOR EVALUATION A CRITERION-REFERENCED TEST

The following check list was designed to evaluate the adequacy of a test that was specifically designed for criterion-referenced use. Although most of the questions would be useful for evaluating any classroom test, positive response are especially crucial for criterion-referenced testing. A negative response indicates an error in construction that should be corrected before the test is administered.

CHECK LIST

	Yes	No
Adequacy of the Test Plan		
1. Does the test plan include a detailed description of the instructional objectives and the content to be measured?	____	____
2. Does the table of specifications clearly indicate the relative emphasis to be given to each objective and each of content?	____	____
3. Is the standard of performance reasonable for the learning outcomes to be measured?	____	____
Adequacy of the Test Items		
4. Are the types of test items appropriate for the learning outcomes to be measured?	____	____
5. Do the test items measure an adequate sample of student performance for each type of interpretation to be made?	____	____
6. Do the test items present clear and definite tasks to be performed?	____	____
7. Are the test items free from nonfunctional material?	____	____
8. Are the test items of appropriate difficulty for the learning outcomes to be measured?	____	____

	Yes	No
9. Are the test items free from technical defects (clues, ambiguity, inappropriate reading level)?	____	____
10. Is the answer to each test item one that experts would agree upon?	____	____
11. Are the items of each type in harmony with the rules for constructing that item type?	____	____
Adequacy of the Test Format		
12. Are the test items that measure the same instructional objective grouped together in the test?	____	____
13. Are the test items arranged in order of increasing difficulty within each section of the test and within the test as a whole (to the extent possible)?	____	____
14. Does the item layout on the page contribute to ease of reading and ease of scoring?	____	____
15. Are the test items numbered in consecutive order?	____	____
16. Are specific, clear directions provided for each section of the test and for the test as a whole?	____	____

Adopted from Gronlund, Norman E. Preparing Criterion-Referenced Tests for Classroom Instruction, The Macmillan Company, 1973.

TABLE OF SPECIFICATIONS

Subcommittee: (Anaerobes & Non-Fastidious Gram-Negative Rods)

MLT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content	55 items	35 items	10 items	100 ite
. Anaerobes A. Cellular Morphology 1. Gram-negative anaerobes a. gram-neg. non-sporeforming rods b. gram-neg. cocci	2	2	1	5
2. Gram-positive anaerobes a. gram-pos. sporeforming rods b. gram-pos. non-sporeforming rods c. gram-positive cocci	2	2	1	5
B. Cultural Characteristics 1. Media a. growth requirements b. inhibitory compounds	2	2	1	5
2. Environmental requirements	2	0	0	2
3. Colonial appearance a. size, shape, consistency etc of colony b. chromogenesis c. effect of media	2	1	0	3
C. Secondary identification 1. Biochemical reaction	2	1	0	3
2. Gas Chromatography	1	0	0	1
D. Specimens 1. Sources	1	1	0	2
2. Collection and transport	1	1	0	2
3. Processing a. primary cultures 4. SAFETY	1	0	0	1
Total	55%	35%	10%	100%

rev. 1981

TABLE OF SPECIFICATIONS

Subcommittee: (Anaerobes & Non-Fastidious Gram-Negative Rods)

MLT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content	55 items	35 items	10 items	100 iter
II. Enteric and other non-fastidious gram-negative rods A. Morphology 1. Shape and arrangement	1	1	0	2
2. Structures i.e. flagella	1	1	0	2
3. Staining Characteristics	1	1	0	2
B. Cultural Characteristics 1. Media a. growth requirements b. inhibitory concentrations c. role of nutrients	10	6	2	18
[illegible]. Environemental requirements	1	1	0	2
3. Colonial appearance a. size, shape, consistency etc. of colony b. chromogenesis c. effect on other media	8	6	2	16
C. Secondary identification 1. Biochemical reactions a. conventional b. rapid systems c. automated systems	12	7	3	22
2. Antigenic structures and serological identification	2	2	0	4
D. Specimen 1. Sources	1	0	0	1
2. Collection and transport	1	0	0	1
3. Processing b. primary culture 6. SAFETY	1	0	0	1
Total	55%	35%	10%	100%

MLT Level

TABLE OF SPECIFICATIONS

Subcommittee: Group II -- Other Bacteria & TB

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content	55 items	35 items	10 items	100 items
Section 1 (Staph. Strep., Neisseria, Branhamella, Hemophilus) (80 ques.)	44	28	8	80
Section 2 (Corynebacterium, Listeria, Erysipelothrix, Pasteurella, Bordetella, Bacillus, Campylobacter, Brucella) (6 ques.)	3	2	1	6
Section 3 (Chlamydia, Mycoplasma, Leptospira, Borrelia, Rickettsia, Treponema, Eikenella, Legionella) (4 ques.)	2	2	0	4
Section 4 (Francisella, Calymmatobacterium, Streptobacillus, Spirillum, Cell Wall Defective Bacteria, Actinobacillus) (0 ques.)	0	0	0	0
Section 5 (Mycobacterium) (10 ques.)	6	3	1	10
Total	55%	35%	10%	100%

TABLE OF SPECIFICATION

MLT Level

Content/Objectives

Group I
obj. # 1
obj. # 2
obj. # 3
obj. # 4
obj. # 5
obj. # 6
obj. # 7
obj. # 10
obj. # 12

Group II
obj. # 1
obj. # 2
obj. # 3
obj. # 4
obj. # 5
obj. # 6
obj. # 7
obj. # 10
obj. # 12

Group III
obj. # 1 State appropriate staining procedure and morphology for each organism.
obj. # 2
obj. # 3 when applicable
obj. # 4
obj. # 5
obj. #10 to include special handling where applicable.

Group IV
No content for MLT level

Group V
obj. # 1 State the appropriate staining reaction.
obj. # 2
obj. # 3
obj. #10

Group Weighting

	MT	MLT
Group I	60	80
Group II	10	6
Group III	6	4
Group IV	4	0
Group V	20	10
	100	100

Objectives

1. State the appropriate gram reaction and morphology for each organism listed.
2. Specify the appropriate isolation media and incubation requirements for each organism.
3. Recognize colonial morphology on primary plating media.
4. Explain the principle of biochemical testing used to identify each organism.
5. Perform the biochemical tests used to identify each organism
6. Determine the appropriate biochemical reactions and serological characteristics of each organism.
7. Interpret results of biochemical/serological procedures.
8. List disease states associated with each organism. -- MT only
9. Explain organisms method of pathogenicity. -- MT only
10. Indicate specimen of choice for culture in suspected cases.
11. Correlate lab data with patient diagnosis and history. -- MT only
12. Recognize simple problems making corrections according to proscribed strategies.

TABLE OF SPECIFICATIONS

Subcommittee: Miscellaneous

MLT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content	55 items	35 items	10 items	100 ite
Miscellaneous Microbiology				
A. Specimen Processing **1. Collection, Transport, and Handling** a. Sources b. Precautions c. Environmental Requirements d. Contaminants	4	2	0	6
2. Media and Reagents a. Selection b. Preparation c. Composition	4	2	0	6
3. Media Inoculation a. Primary Isolation b. Special Isolation	3	2	1	6
4. Incubation a. Types b. Temperature c. Atmosphere	3	2	1	6
5. Stains and Microscopic Preparations a. Types (1) Gram (a) Theory (b) Reaction (c) Procedure (2) Acid Fast (a) Theory (b) Reaction (c) Procedure (3) Other Stains (4). Unstained Preparations	4	1	1	6
6. Sterilization and Disinfection a. Terminology b. General Concepts c. Methods (1) Physical (2) Chemical	3	2	0	5
Total	55%	35%	10%	100%

2

TABLE OF SPECIFICATIONS

Subcommittee: Miscellaneous

MLT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content	55 items	35 items	10 items	100 ite
Misc. Microbiology,Continued.				
B. Susceptibility Testing	6	3	2	11
1. Antimicrobial Agents				
a. Class				
b. Modes of Action				
c. Sites of Action				
2. Susceptibility Test Procedures	8	8	5	21
a. Dilution				
(1) Minimal Inhibitory Concentration (MIC)				
(2) Minimum Bactericidal Concentration (MBC)				
b. Kirby- Bauer Disk Diffusion Test				
(1) Variables				
(2) Correlation with MIC				
(3) Zone Size Relationship with Antimicrobial Agents				
c. Mycobacteria Susceptibility				
d. Exempt Organisms				
3. Antimicrobial Assays	2	1	0	3
a. Schlicter Test				
b. Serum Assays				
C. Epidemiology				
1. Terminology	4	0	0	4
2. Principles	1	0	0	1
3. Methods	1	1	0	2
4. Host-Parasite Relationships	2	1	0	3
a. Pathogenicity				
b. Virulence				
c. Specificity				
5. Modes of Transmission	1	1	0	2
6. Nosocomial Infections	1	1	0	2
7. Microbiology Laboratory Roles	0	1	0	1
Total	55%	35%	10%	100%

TABLE OF SPECIFICATIONS

Subcommittee: Miscellaneous

MLT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content	55 items	35 items	10 items	100 iter
Misc. Microbiology , Continued.				
D. Quality Assurance				
1. Equipment and Materials a. Media b. Mechanical Equipment c. Reagents d. Specimens	3	4	0	7
2. Personnel a. Policies b. Performance	1	0	0	1
3. Documentation of Data	1	1	0	2
E. Safety				
1. Aseptic Techniques	1	0	0	1
2. Proper Use of Equipment	0	0	0	0
3. Safety Equipment	1	0	0	1
4. Potential Hazards	0	1	0	1
5. Disposal	1	0	0	1
6. Decontamination	0	1	0	1
Total	55%	35%	10%	100%

TABLE OF SPECIFICATIONS

Subcommittee: ____________________

MLT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content - Mycology	55 items	35 items	10 items	100 it
I Classification of medically important fungi				
A Phytogenetic (Eumycota)	2			
1 Mastigomycotina				
2 Zygomycotina				
3 Ascomycotina				
4 Basidiomycotina				
5 Deuteromycotina				
B Disease-oriented mycoses	1			
1 Cutaneous mycoses				
2 Subcutaneous mycoses				
3 Systemic mycoses				
4 Opportunistic mycoses				
II Elements of mycology		1	1	
A Macroscopic morphology				
1 Characteristics on different medium				
2 Age of culture: conditions of incubation				
3 Topography				
4 Pigment: surface & reverse				
5 Texture				
a granular				
b powdery				
c suede				
d glabrous				
e wooly				
6 Size				
7 Correlation of colony growth on various media				
B Microscopic morphology				
1 Hyphae	1	1		
Total	55%	35%	10%	100%

TABLE OF SPECIFICATIONS

Subcommittee: ____________________

MLT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content	55 items	35 items	10 items	100 it
I B 1 (Cont'd.)				
a diameter	1	1		
b pigmented				
1) hyline				
2) dematiaceous				
c septate verses non-septate	1			
d vegetative	1			
1) racquet				
2) favic chandelier				
3) pectinate bodies				
4) nodular organs				
5) spiral				
e aerial	1			
1) sporangiophore				
2) conidiophore				
3) aleuriospores - macro & micro				
2 Conidia	2	1		
a sporangia; sporangio spores				
b asci; ascospores				
c chlamydospores				
d blastoconidia				
e arthroconidia				
II Collection & processing of specimens	3	2	1	
A Specimen source				
1 skin scrapings				
2 nail scrapings/clippings				
3 hair				
4 pus/exudates				
5 spinal fluid				
6 sputum/other respiratory secretions				
Total	55%	35%	10%	100

TABLE OF SPECIFICATIONS

Subcommittee:________________________

MLT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpre-tation	Tax. 3 Problem Solving	Total
Content - Mycology	55 items	35 items	10 items	100 it
III A (Cont'd.)				
7 bone marrow/blood				
8 body fluid				
9 biopsy & autopsy specimens				
B Processing (safety & methods)	2	1		
1. incubation temperature				
2 time of incubation				
3 technique of collection				
4 time between collection & culture/transport				
5 safety precautions				
C Staining/slide preparation	4	2	1	
1 direct mounts				
2 KOH mounts				
3 lactophenol cotton blue				
4 India ink				
5 Hank's acid fast stain				
6 Gram stain				
7 periodic acid schiff stain				
8 Giemsa stain				
D Special techniques	2	2	1	
1 tease mount				
2 Scotch-tape mount				
3 slide culture				
4 Wood's lamp examination				
5 incubation temperatures				
IV Media & reagents	2	3		
A Primary test media				
1 brain heart infusion agar (BHI)				
2 brain heart infusion agar with antibiotics				
3 biphasic blood culture medium				
Total	55%	35%	10%	100%

TABLE OF SPECIFICATIONS

Subcommittee:____________________

MLT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content - Mycology	55 items	35 items	10 items	100 i
IV A (Cont'd.)				
4 dermatophyte test medium (DTM)				
5 inhibitory mold agar (IMA)				
6 Sabourand's 2% dextrose agar				
7 SABHI			?	
8 mycosel				
B Secondary differential test media	6	4	1	
1 ascospore agar				
2 cornmeal agar with tween 80 & trypan blue				
3 cottonseed agar				
4 Czapek's agar				
5 Niger seed agar				
6 nitrate reduction medium				
7 potato dextrose agar				
8 rice medium				
9 trichophyton agars				
10 tyrosine agar				
11 urea agar				
12 xanthine agar				
13 yeast fermentation base agar				
14 yeast nitrogen base agar				
V Identification techniques				
A Biochemical				
1 assimilation test	1	3	1	
2 fermentation test	1			
B physiological				
C nutritional-growth requirements				
D special techniques				
Total	55%	35%	10%	100%

TABLE OF SPECIFICATIONS

Subcommittee:____________________

MLT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content - Mycology	55 items	35 items	10 items	100 it
VI Drug susceptibility studies	1	1		
A drugs to be tested				
B assay procedures				
C interpretation				
VII Bioassay - antifungal drugs	0			
A procedure				
B interpretation of data				
C clinical relevance				
II Serological test	2	2	1	
A latex agglutination (LA)				
B complement fixation (CF)				
C immunodiffusion (ID)				
D counter immunoelectrophoresis (CIE)				
X Clinically important fungi				
A systemic mycoses	3	1	1	
1 *Blastomyces dermatitidis*				
2 *Coccidioides immitis*				
3 *Histoplasma capsulatum*				
4 *Cryptococcus neoformans*				
5 *Paracoccidioides brasiliensis*				
B Subcutaneous mycoses	3	2	1	
1 *Actinomyces ssp.*				
2 *Cladosporium carrionii*				
3 *Fonsecaea ssp.*				
4 *Nocardia asteroides*				
5 *Petriellidium boydii*				
6 *Phialophora ssp.*				
7 *Sporothrix schenckii*				
Total	55%	35%	10%	100%

TABLE OF SPECIFICATIONS

Subcommittee: ____________________

MLT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content - Mycology	55 items	35 items	10 items	100 ite
IX B (Cont'd.)				
8 Streptomyces ssp.				
C Cutaneous mycoses	4	2		
1 Microsporum ssp.				
2 Trichophyton ssp.				
3 Epidermophyton floccosum				
D Cutaneous and/or systemic	2	1		
1 Actinomyces ssp.				
2 Candida ssp.				
3 Cryptococcus ssp.				
4 Geotrichum candidum				
5 Nocardia ssp.				
6 Torulopsis ssp.				
E Opportunistic mycoses	6	4	1	
1 Absidia ssp.				
2 Alternaria ssp.				
3 Aspergillus ssp.				
4 Aureobasidium pullulans				
5 Candida ssp.				
6 Cladosporium wernecki				
7 Curvularia				
8 Fusarium				
9 Geotrichum candidum				
10 Mucor ssp.				
11 Paecilomyces ssp.				
12 Penicillium ssp.				
13 Pityrosporum (Malasseria furfur)				
14 Rhizopus ssp.				
15 Rhodotorula ssp.				
16 Scopulariopsis ssp.				
17 Syncephalastrum ssp.				
18 Trichosporum beigelli (cutaneum)				
19 Torulopsis ssp.				
20 Others				
Total	55%	35%	10%	100%

TABLE OF SPECIFICATIONS

Subcommittee:____________________

MLT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content - Mycology	55 items	35 items	10 items	100 it
X Quality Control	3	1		
A media				
B equipment				
C reagents				
D maintenance of stock cultures				
Total	55%	35%	10%	100%

TABLE OF SPECIFICATIONS

Subcommittee: ______________________

MLT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	To
Content - Parasitology	55 items	35 items	10 items	10
I Parasitism & Host Relationship				
A Definitions	3	1		
B Modes of transmission for:	3			
1 intestinal & atrial parasites;		2		
2 blood & tissue parasites.				
II Parasites: geographic distribution, morphology, life cycles, host habitat, disease association and identification of: Protozoa				
1 Amoebae:	5	3	2	
a Entamoeba				
1) E. histolytica				
2) E. coli				
3) E. hartmanni				
4) E. polecki				
b Endolimax nana				
c Iodamoeba butschlii				
d Dientamoeba fragilis				
e Naegleria & hartmanella sp				
2 Flagellates:	4	3	2	
a Giardia lamblia				
b Chilomastix mesnili				
c Trichomoras				
1) T. hominis				
2) T. vacinalis				
3) T. terax				
d Isospora belli				
e Leishmania	1			
Total	55%	35%	10%	10

TABLE OF SPECIFICATIONS

Subcommittee: ____________________

MLT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content - Parasitology	55 items	35 items	10 items	100 ite
II 2e (Cont'd.)				
1) L. donavani				
2) L. tropica				
3) L. braziliensis				
f Trypanasoma	1			
1) T. gambiense				
2) T. rhodesiense				
3) T. cruzi				
3 Ciliates:				
Balantidium coli				
4 Sporozoa:	4	–	2	
a Plasmodium				
1) P. vivax				
2) P. malariae				
3) P. falciparum				
4) P. ovale				
b Toxoplasma gondii				
c Pneumocystis carinii				
d Sarcocystis lindemanni				
5 Babesia				
III Helminths				
1 Nematodes:	5	4	1	
a Enterobius vermicularis				
b Ascaris lumbricoides				
c Strongylcides stercoralis				
d Trichiostrongylus sp.				
e Trichuris trichuira				
f Ancylostoma duodenale				
g Necator americanus				
h Trichinella spiralis				
i Wuchereria bancrofti				
Total	55%	35%	10%	100%

TABLE OF SPECIFICATIONS

Subcommittee: ____________________

MLT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content - Parasitology	55 items	35 items	10 items	100 ite
II, 1 (Cont'd.)				
j Brugia malayi				
k Loa loa				
l Onchocerca volvulus				
m Acanthocheilonema perstans				
n Mansonella ozzardi				
o Dracunculus medinensis				
p Toxocara sp.				
q Capillaria sp.				
2 Cestodes:	5	3	1	
a Taenia saginata				
b Taenia solium				
c Hymenolepsis nana				
d Hymenolepsis diminuta				
e Diphyllobothrium latum				
f Echinococcus granulosus				
g Echniococcus multilocularis				
h Dipylidium caninum				
3 Trematodes:	5	2	1	
a Schistosoma				
1) S. mansoni				
2) S. japonicum				
3) S. hematobium				
b Paragonimus westermani				
c Clonorchis sinensis				
d Fasciola hepatica				
e Fasciolopsis buski				
f Heterophyes heterophyes				
Arthropods (Vectors)				
Mosqiutoes		2		
1 Anopheles sp.				
2 Aedes sp.				
Total	55%	35%	10%	100%

TABLE OF SPECIFICATIONS

Subcommittee: ____________________

MLT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content - Parasitology	55 items	35 items	10 items	100 ite
V A (Cont'd.)				
3 Culex sp.				
4 Mansonia sp.				
B Flies	1			
1 Similium sp.				
2 Phlebotomus sp.				
3 Musca sp.				
C Fleas				
D Ticks	1			
[illegible] Mites				
F Lice				
1 Pediculus				
2 Phthirus pubis				
Laboratory Procedures	4	3		
A Specimens				
1 Sources:				
a stool				
b blood				
c spinal fluid				
d sputum				
e urine				
f body tissue				
2 Preservation:	3	2		
a refrigeration				
b MIF - Merthiolate Iodine Formalin				
c Formalin				
d PVA - polyvinyl alcohol				
3 Macroscopic examination contaminants & artifacts	1	1		
Total	55%	35%	10%	100%

TABLE OF SPECIFICATIONS

Subcommittee: ____________________

MLT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content - Parasitology	55 items	35 items	10 items	100 ite
C Stains/Slide Preparations	4	3	1	
1 Direct wet mount				
a saline				
b iodine				
2 Trichrome stain				
3 Iron hematoxylin				
4 Giemsa stain				
5 Wright stain				
6 thin blood films				
7 thick blood films				
Microscopic Examination	2	1		
1 calibration of micrometer				
2 artifacts				
D Special Techniques				
1 zinc sulfate flotation	3	1		
2 formalin-ether concentration				
3 concentration techniques for blood				
Total	55%	35%	10%	100%

MICROBIOLOGY C1

TABLE OF SPECIFICATIONS

Subcommittee: (Anaerobes & Non-Fastidious Gram-Negative Rods)

MT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content	25 items	40 items	35 items	100 items
I. Anaerobes A. Cellular Morphology 1. Gram-negative anaerobes a. gram-neg. non-sporeforming rods b. gram-negative cocci	1	2	2	5
2. Gram-positive anaerobes a. gram-pos. sporeforming rods b. gram-pos. non-sporeforming rods c. gram-positive cocci	1	2	2	5
B. Cultural Characteristics 1. Media a. growth requirements b. inhibitory compounds	1	2	2	5
2. Environmental requirements	1	1	1	3
3. Colonial appearance a. size, shape, consistency etc. of colony b. chromogenesis c. effect of media	1	3	0	4
C. Secondary identification 1. Biochemical reaction	0	2	1	3
2. Gas Chromatography	1	0	0	1
D. Specimens 1. Sources	1	0	0	1
2. Collection and transport	0	0	1	1
Processing a. primary cultures b SAFETY	0	0	1	1
Total	25%	40%	35%	100%

TABLE OF SPECIFICATIONS

Subcommittee:(Anaerobes & Non-Fastidious Gram-Negative Rods)

MT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content	25 items	40 items	35 items	100 items
II. Enteric and other non-fastidious gram-negative rods A. Morphology 1. Shape and arrangement	0	0	0	0
2. Structures i.e. flagella	1	0	0	1
3. Staining Characteristics	1	0	0	1
B. Cultural Characteristics 1. Media a. growth requirements b. inhibitory concentrations c. role of nutrients	5	10	9	24
2. Environmental requirements	1	0	1	2
3. Colonial appearance a. size,shape,consistency etc. of colony b. chromogenesis c. effect on other media	1	3	5	9
C. Secondary identification 1. Biochemical reactions a. conventional b. rapid systems c. automated systems	7	10	7	24
2. Antigenic structures and serological identification	0	3	2	5
D. Specimen 1. Sources	1	0	0	1
2. Collection and transport	0	1	1	2
3. Processing a. primary culture b. SAFETY	1	0	0	1
Total	25%	40%	35%	100%

MT LEVEL

TABLE OF SPECIFICATIONS

Subcommittee: Group II -- Other Bacteria & TB

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content	25 items	40 items	35 items	100 items
Section 1 (Staph., Strep., Neisseria, Branhamella, Hemophilus) (60 ques.)	15	24	21	60
Section 2 (Corynebacterium, Listeria, Erysipelothrix, Pasteurella, Bordetella, Bacillus, Campylobacter, Brucella) (10 ques.)	3	3	4	10
Section 3 (Chlamydia, Mycoplasma, Leptospira, Borrelia, Rickettsia, Treponema, Eikenella, Legionella) (6 ques.)	1	3	2	6
Section 4 (Francisella, Calymmatobacterium, Streptobacillus, Spirillum, Cell Wall Defective Bacteria, Actinobacillus) (4 ques.)	1	2	1	4
Section 5 (Mycobacterium) (20 ques.)	5	8	7	20
Total	25%	40%	35%	100%

Group Weighting

	MT	MLT
Group I	60	80
Group II	10	6
Group III	6	4
Group IV	4	0
Group V	20	10
	100	100

Objectives

1. State the appropriate gram reaction and morphology for each organism listed.
2. Specify the appropriate isolation media and incubation requirements for each organism.
3. Recognize colonial morphology on primary plating media.
4. Explain the principle of biochemical testing used to identify each organism.
5. Perform the biochemical tests used to identify each organism
6. Determine the appropriate biochemical reactions and serological characteristics of each organism.
7. Interpret results of biochemical/serological procedures.
8. List disease states associated with each organism. -- MT only
9. Explain organisms method of pathogenicity. -- MT only
10. Indicate specimen of choice for culture in suspected cases.
11. Correlate lab data with patient diagnosis and history. -- MT only
12. Recognize simple problems making corrections according to proscribed strategies.

TABLE OF SPECIFICATIONS

MT Level

Content/Objectives

Group I
obj. # 1
obj. # 2
obj. # 3
obj. # 4
obj. # 5
obj. # 6
obj. # 7
obj. # 8
obj. # 9
obj. # 10
obj. # 11
obj. # 12

Group II
obj. # 1
obj. # 2
obj. # 3
obj. # 4
obj. # 5
obj. # 6
obj. # 7
obj. # 8
obj. # 9
obj. # 10
obj. # 12

Group III
obj. # 1
obj. # 2
obj. # 3 when applicable
obj. # 4 when applicable
obj. # 5 when applicable
obj. # 6 when applicable
obj. # 7 when applicable
obj. # 9
obj. # 10 and special handling when appropriate
obj. # 12

Group IV
obj. # 1 state approp. stain reaction & morph.
obj. # 2
obj. # 8
obj. # 9
obj. # 10
obj. # 12

Group V
obj. # 1
obj. # 2
obj. # 3
obj. # 4
obj. # 5
obj. # 6 but not serological testing
obj. # 7 interpret the results of biochemical tests to distinguish TB from nonTB.
obj. # 8
obj. # 9
obj. # 10
obj. # 12

TABLE OF SPECIFICATIONS

Subcommittee:______________________

MT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content - Mycology	25 items	40 items	35 items	100 items
Classification of medically important fungi				
A Phytogenetic (Eumycota)	1			
1 Mastigomycotina				
2 Zygomycotina				
3 Ascomycotina				
4 Basidiomycotina				
5 Deuteromycotina	1			
B Disease-oriented mycoses		1	1	
1 Cutaneous mycoses				
2 Subcutaneous mycoses				
3 Systemic mycoses				
4 Opportunistic mycoses				
I Elements of mycology				
A Macroscopic morphology	1	3	1	
1 Characteristics on different medium				
2 Age of culture: conditions of incubation				
3 Topography				
4 Pigment: surface & reverse				
5 Texture				
a granular				
b powdery				
c suede				
d glabrous				
e wooly				
6 Size				
7 Correlation of colony growth on various media				
B Microscopic morphology				
1 Hyphae	1	2		
Total	25%	40%	35%	100%

TABLE OF SPECIFICATIONS

Subcommittee:____________________

MT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content	25 items	40 items	35 items	100 items
I B 1 (Cont'd.)				
a diameter				
b pigmented				
1) hyline				
2) dematiaceous				
c septate verses non-septate				
d vegetative	1			
1) racquet				
2) favic chandelier				
3) pectinate bodies				
4) nodular organs				
5) spiral				
e aerial	1	2	2	
1) sporangiophore				
2) conidiophore				
3) aleuriospores - macro & micro				
2 Conidia	1	1	1	
a sporangia; sporangio spores				
b asci; ascospores				
c chlamydospores				
d blastoconidia				
e arthroconidia				
II Collection & processing of specimens	1	2	2	
A Specimen source				
1 skin scrapings				
2 nail scrapings/clippings				
3 hair				
4 pus/exudates				
5 spinal fluid				
6 sputum/other respiratory secretions				
Total	25%	40%	35%	100%

TABLE OF SPECIFICATIONS

Subcommittee:____________________

MT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpre-tation	Tax. 3 Problem Solving	Total
Content - Mycology	25 items	40 items	35 items	100 items
II A (Cont'd.)				
7 bone marrow/blood				
8 body fluid				
9 biopsy & autopsy specimens				
B Processing (safety & methods)	1	2	2	
1. incubation temperature				
2 time of incubation				
3 technique of collection				
4 time between collection & culture/transport				
5 safety precautions				
C Staining/slide preparation				
1 direct mounts		1		
2 KOH mounts				
3 lactophenol cotton blue				
4 India ink	1	1		
5 Hank's acid fast stain			1	
6 Gram stain				
7 periodic acid schiff stain				
8 Giemsa stain				
D Special techniques	1	1	2	
1 tease mount				
2 Scotch-tape mount				
3 slide culture				
4 Wood's lamp examination		1		
5 incubation temperatures				
V Media & reagents				
A Primary test media		1		
1 brain heart infusion agar (BHI)				
2 brain heart infusion agar with antibiotics		1	1	
3 biphasic blood culture medium				
Total	25%	40%	35%	100%

TABLE OF SPECIFICATIONS

Subcommittee:____________________

MT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content - Mycology	25 items	40 items	35 items	100 items
V A (Cont'd.)				
4 dermatophyte test medium (DTM)	1			
5 inhibitory mold agar (IMA)				
6 Sabourand's 2% dextrose agar				
7 SABHI				
8 mycosel				
B Secondary differential test media	1	3	2	
1 ascospore agar				
2 cornmeal agar with tween 80 & trypan blue				
3 cottonseed agar				
4 Czapek's agar				
5 Niger seed agar				
6 nitrate reduction medium				
7 potato dextrose agar				
8 rice medium				
9 trichophyton agars				
10 tyrosine agar				
11 urea agar				
12 xanthine agar				
13 yeast fermentation base agar				
14 yeast nitrogen base agar				
Identification techniques	1	1	2	
A Biochemical				
1 assimilation test				
2 fermentation test				
B physiological				
C nutritional-growth requirements				
D special techniques				
Total	25%	40%	35%	100%

TABLE OF SPECIFICATIONS

Subcommittee: ____________________

MT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content - Mycology	25 items	40 items	35 items	100 items
I Drug susceptibility studies		1	1	
A drugs to be tested				
B assay procedures				
C interpretation				
II Bioassay - antifungal drugs		1	1	
A procedure				
B interpretation of data				
C clinical relevance				
III Serological test	1	2	1	
A latex agglutination (LA)				
B complement fixation (CF)				
C immunodiffusion (ID)				
D counter immunoelectrophoresis (CIE)				
Clinically important fungi				
A systemic mycoses	1	2	4	
1 *Blastomyces dermatitidis* 2 *Coccidioides immitis* 3 *Histoplasma capsulatum* 4 *Cryptococcus neoformans* 5 *Paracoccidioides brasiliensis*				
B Subcutaneous mycoses	1	2	2	
1 *Actinomyces ssp.* 2 *Cladosporium carrionii* 3 *Fonsecaea ssp.* 4 *Nocardia asteroides* 5 *Petriellidium boydii* 6 *Phialophora ssp.* 7 *Sporothrix schenckii*				
Total	25%	40%	35%	100%

TABLE OF SPECIFICATIONS

Subcommittee: ____________________

MT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content - Mycology	25 items	40 items	35 items	100 items
X B (Cont'd.)				
8 Streptomyces ssp.				
C Cutaneous mycoses	2	1	1	
1 Microsporum ssp.				
2 Trichophyton ssp.				
3 Epidermophyton floccosum				
D Cutaneous and/or systemic	1	2	2	
1 Actinomyces ssp.				
2 Candida ssp.				
3 Cryptococcus ssp.				
4 Geotrichum candidum				
5 Nocardia ssp.				
6 Torulopsis ssp.				
E Opportunistic mycoses	2	4	3	
1 Absidia ssp.				
2 Alternaria ssp.				
3 Aspergillus ssp.				
4 Aureobasidium pullulans				
5 Candida ssp.				
6 Cladosporium wernecki				
7 Curvularia				
8 Fusarium				
9 Geotrichum candidum				
10 Mucor ssp.				
11 Paecilomyces ssp.				
12 Penicillium ssp.				
13 Pityrosporum (Malasseria furfur)				
14 Rhizopus ssp.				
15 Rhodotorula ssp.				
16 Scopulariopsis ssp.				
17 Syncephalastrum ssp.				
18 Trichosporum beigelli (cutaneum)				
19 Torulopsis ssp.				
20 Others				
Total	25%	40%	35%	100%

TABLE OF SPECIFICATIONS

Subcommittee: ____________________

MT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content - Mycology	25 items	40 items	35 items	100 items
Quality Control	1	2	3	
A media				
B equipment				
C reagents				
D maintenance of stock cultures				
Total	25%	40%	35%	100%

TABLE OF SPECIFICATIONS

Subcommittee:____________________

MT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content - Parasitology	25 items	40 items	35 items	100 items
Parasitism & Host Relationship A Definitions B Modes of transmission for: 1 intestinal & atrial parasites; 2 blood & tissue parasites.	2	1	1	
Parasites: geographic distribution, morphology, life cycles, host habitat, disease association and identification of: Protozoa				
1 Amoebae: a Entamoeba 1) E. histolytica 2) E. coli 3) E. hartmanni 4) E. polecki b Endolimax nana c Iodamoeba butschlii d Dientamoeba fragilis e Naegleria & hartmanella sp	2	3	4	
2 Flagellates: a Giardia lamblia b Chilomastix mesnili c Trichomonas 1) T. hominis 2) T. vaginalis 3) T. tenax d Isospora belli e Leishmania	2	4	6 1	
Total	25%	40%	35%	100%

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Subcommittee:____________________

MT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content - Parasitology	25 items	40 items	35 items	100 items
2e (Cont'd.)				
1) L. donavani				
2) L. tropica				
3) L. braziliensis				
f Trypanasoma			1	
1) T. gambiense				
2) T. rhodesiense				
3) T. cruzi				
3 Ciliates:	1			
Balantidium coli				
4 Sporozoa:	2	5	3	
a Plasmodium				
1) P. vivax				
2) P. malariae				
3) P. falciparum				
4) P. ovale				
b Toxoplasma gondii				
c Pneumocystis carinii				
d Sarcocystis lindemanni				
5 Babesia				
III Helminths	3	5	4	
1 Nematodes:				
a Enterobius vermicularis				
b Ascaris lumbricoides				
c Strongyloides stercoralis				
d Trichiostrongylus sp.				
e Trichuris trichuira				
f Ancylostoma duodenale				
g Necator americanus				
h Trichinella spiralis				
i Wuchereria bancrofti				
Total	25%	40%	35%	100%

TABLE OF SPECIFICATIONS

Subcommittee:____________________

MT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpre-tation	Tax. 3 Problem Solving	Total
Content - Parasitology	25 items	40 items	35 items	100 items
I , 1 (Cont'd.)				
j Brugia malayi				
k Loa loa				
l Onchocerca volvulus				
m Acanthocheilonema perstans				
n Mansonella ozzardi				
o Dracunculus medinensis				
p Toxocara sp.				
q Capillaria sp.				
2 Cestodes:	2	4	4	
a Taenia saginata				
b Taenia solium				
c Hymenolepsis nana				
d Hymenolepsis diminuta				
e Diphyllobothrium latum				
f Echinococcus granulosus				
g Echniococcus multilocularis				
h Dipylidium caninum				
3 Trematodes:	2	3	3	
a Schistosoma				
1) S. mansoni				
2) S. japonicum				
3) J. hematobium				
b Paragonimus westermani				
c Clonorchis sinensis				
d Fasciola hepatica				
e Fasciolopsis buski				
f Heterophyes heterophyes				
rthropods (Vectors)				
Mosqiutoes				
1 Anopheles sp.		2		
2 Aedes sp.				
Total	25%	40%	35%	100%

TABLE OF SPECIFICATIONS

Subcommittee:______________________

MT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content - Parasitology	25 items	40 items	35 items	100 items
IV A (Cont'd.)				
3 Culex sp. 4 Mansonia sp.				
B Flies	1	1		
1 Similium sp. 2 Phlebotomus sp. 3 Musca sp.				
C Fleas				
D Ticks	1	1		
E Mites				
F Lice 1 Pediculus 2 Phthirus pubis				
V Laboratory Procedures A Specimens	2	3	2	
1 Sources: a stool b blood c spinal fluid d sputum e urine f body tissue				
2 Preservation: a refrigeration b MIF - Merthiolate Iodine Formalin c Formalin d PVA - polyvinyl alcohol	2	2	2	
3 Macroscopic examination. contaminants & artifacts		1	1	
Total	25%	40%	35%	100%

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MT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content - Parasitology	25 items	40 items	35 items	100 items
C Stains/Slide Preparations	2	3	3	
1 Direct wet mount				
a saline				
b iodine				
2 Trichrome stain				
3 Iron hematoxylin				
4 Giemsa stain				
5 Wright stain				
6 thin blood films				
7 thick blood films				
C Microscopic Examination		1	1	
1 calibration of micrometer				
2 artifacts				
D Special Techniques	1	1	1	
1 zinc sulfate flotation				
2 formalin-ether concentration				
3 concentration techniques for blood				
Total	25%	40%	35%	100%

TABLE OF SPECIFICATIONS

Subcommittee: Miscellaneous

MT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content	25 items	40 items	35 items	100 items
Miscellaneous Microbiology				
A. Specimen Processing				
1. Collection, Transport, and Handling a. Sources b. Precautions c. Environmental Requirements d. Contaminents	1	1	0	2
2. Media and Reagents a. Selection b. Preparation c. Composition	2	2	2	6
3. Media Inoculation a. Primary Isolation b. Special Isolation	2	2	3	7
4. Incubation a. Types b. Temperature c. Atmosphere	2	2	2	6
5. Stains and Microscopic Preparations a. Types (1) Gram (a) Theory (b) Reaction (c) Procedure (2) Acid Fast (a) Theory (b) Reaction (c) Procedure (3) Other Stains (4) Unstained Preparations	2	2	5	9
Sterilization and Disinfection a. Terminology b. General Concepts c. Methods ~~(1) Chemical (2) Physical~~	2	2	1	5
Total	25%	40%	35%	100%

TABLE OF SPECIFICATIONS

Subcommittee: Miscellaneous

MT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content	25 items	40 items	35 items	100 items
Misc. Microbiology, Continued.				
B. Susceptibility Testing				
1. Antimicrobial Agents	2	5	2	9
a. Class				
b. Modes of Action				
c. Sites of Action				
2. Susceptibility Test Procedures	2	5	8	15
a. Dilution				
(1) Minimal Inhibitory Concentration (MIC)				
(2) Minimum Bactericidal Concentration (MBC)				
b. Kirby-Bauer Disk Diffusion Test				
(1) Variables				
(2) Correlation with MIC				
(3) Zone Size Relationship with Antimicrobial Agents				
c. Mycobacteria Susceptibility				
d. Exempt Organisms				
3. Antimicrobial Assays	1	5	5	11
C. Epidemiology				
1. Terminology	1	0	0	1
2. Principles	0	1	0	1
3. Methods	0	2	0	2
4. Host- Parasite Relationships	1	2	2	5
a. Pathogenicity				
b. Virulence				
c. Specificity				
5. Modes of Transmission	0	1	0	1
6. Nosocomial Infections	1	1	1	3
7. Microbiology Laboratory Roles	0	0	2	2
Total	25%	40%	35%	100%

TABLE OF SPECIFICATIONS

Subcommittee: Miscellaneous

MT Level

Objectives	Tax. 1 Recall	Tax. 2 Interpretation	Tax. 3 Problem Solving	Total
Content	25 items	40 items	35 items	100 items
. Misc. Microbiology, Continued.				
D. Quality Assurance				
1. Equipment and Materials	1	4	1	6
a. Media				
b. Mechanical Equipment				
c. Reagents				
d. Specimens				
2. Personnel	1	0	0	1
a. Policies				
b. Performance				
3. Documentation of Data	1	1	1	3
E. Safety				
1. Aseptic Techniques	1	0	0	1
2. Proper Use of Equipment	0	1	0	1
3. Safety Equipment	1	0	0	1
4. Potential Hazards	0	1	0	1
5. Disposal	1	0	0	1
6. Decontamination	0	0	0	0
Total	25%	40%	35%	100%

C2

MLT MICROBIOLOGY EXAM - A

1. All members of the Enterobacteriaceae are:

   a. gram positive cocci.
   b. gram negative cocci.
   c. gram positive bacilli.
   d. gram negative bacilli.

2. Which member of the Enterobacteriaceae does not possess a flagella?

   a. Escherichia coli
   b. Proteus mirabilis
   c. Salmonella typhimurium
   d. Shigella boydii

3. Enterobacteriaceae will grow well on:

   a. Columbia CNA agar.
   b. MacConkey agar.
   c. Mannitol Salt agar.
   d. Phenylethylalcohol agar.

4. A selective medium for the isolation of Salmonella typhi is:

   a. Bismuth Sulfite agar
   b. Lysine Iron agar.
   c. Eosin Methylene Blue agar.
   d. Triple Sugar Iron agar.

5. The best means to differentiate members of the Enterobacteriaceae from other non-fastidious gram negative rods is their reaction on:

   a. Phenylethylalcohol agar.
   b. Simmons Citrate agar.
   c. Triple Sugar Iron agar.
   d. Xylose Lysine Desoxycholate agar.

6. A gram negative bacilli that can utilize Simmons Citrate as its sole source of carbon is:

   a. Citrobacter freundii.
   b. Escherichia coli.
   c. Morganella morganii.
   d. Shigella boydii.

7. The deamination of phenylalanine results in the formation of:

   a. ammonia.
   b. hydrogen peroxide.
   c. phenylpyruvic acid.
   d. tryptophan.

8. Black-centered colonies on Salmonella-Shigella agar indicate that the bacterium:

   a. ferments lactose.
   b. ferments xylose.
   c. produces black pigment.
   d. produces hydrogen sulfide.

9. The characteristic colonial morphology of Klebsiella pneumoniae on MacConkey agar is:

   a. dry.
   b. flat.
   c. mucoid.
   d. metallic in color.

10. Which member of the Enterobacteriaceae can produce yellow pigmented colonies on blood agar?

    a. Edwardsiella tarda.
    b. Enterobacter sakazakii.
    c. Pseudomonas aeruginosa.
    d. Serratia marcescens.

11. Which member of the Enterobacteriaceae is a lactose-fermenter?

    a. Citrobacter diversus.
    b. Escherichia coli.
    c. Morganella morganii.
    d. Pseudomonas aeruginosa.

12. Members of the family Enterobacteriaceae characteristically:

    a. ferment glucose.
    b. liquify gelatin.
    c. produce DNase.
    d. utilize malonate.

13. Organisms of the Genus Aeromonas may be differentiated from Enterobacteriaceae by the:

    a. catalase test.
    b. oxidase test.
    c. fermentation of carbohydrates.
    d. ability to grow on differential and selective plating media.

14. Alkalescens-dispar is the anaerogenic, non-motile biotype of:

    a. Alcaligenes faecalis.
    b. Escherichia coli.
    c. Salmonella typhi.
    d. Yersinia enterocolitica.

15. Pseudomonads are generally:

    a. atrichous.
    b. monotrichous.
    c. peritrichous.
    d. loptotrichous.

16. All species of Klebsiella:

    a. are non-motile.
    b. are indole positive.
    c. can breakdown ornithine.
    d. do not utilize citrate as a sole source of carbon.

17. Rapid methods in the identification of Enterobacteriaceae may include ALL of the following EXCEPT:

    a. API system.
    b. Enterotube system.
    c. Minitek system.
    d. TSI system.

18. The Vi antigen of Salmonella typhi is a:

    a. capsular antigen.
    b. flagellar antigen.
    c. polyvalent antigen.
    d. somatic antigen.

19. The microorganism most frequently isolated from urinary tract infections is:

    a. Corynebacterium hoffmanii.
    b. Escherichia coli.
    c. Klebsiella pneumoniae.
    d. Staphylococcus epidermidis.

20. A gram stain of a sputum shows many WBCs with a moderate amount of short gram-negative rods. Which microorganism is most likely to be isolated from this specimen?

    a. Borrelia vincentii.
    b. Corynebacterium diptheriae.
    c. Klebsiella pneumoniae.
    d. Streptococcus pneumoniae.

21. Using a flagellar stain, a peritrichous bacterium would appear as having flagella

    a. at both ends of the cell.
    b. at one end of the cell only.
    c. grouped in tufts.
    d. surrounding the entire cell.

22. Swarming on a Sheep Blood agar plate is a characteristic of:

    a. Citrobacter species.
    b. Klebsiella species.
    c. Proteus species.
    d. Pseudomonas species.

23. After the addition of Kovac's reagent to an inoculated tube of SIM or MIO medium, a pink color appears. A bacterium which is capable of producing this type of reaction is:

    a. Escherichia coli.
    b. Enterobacter aerogenes.
    c. Proteus mirabilis.
    d. Serratia marcescens.

24. A positive ONPG test would detect a slow lactose fermenter such as:

    a. Edwardsiella tarda.
    b. Moraxella
    c. Pseudomonas aeruginosa.
    d. Shigella sonnei.

25. A gram negative bacillus isolated from a stool specimen is presumptively identified as one of the Salmonella species. This organism would produce:

    a. colorless colonies with black centers on XLD agar.
    b. mucoid colonies on EMB agar.
    c. pink colonies on MacConkey agar.
    d. yellow colonies on Hektoen Enteric Agar.

26. Colonies that are green without black centers on Hektoen Enteric agar could be:

    a. Escherichia coli.
    b. Salmonella typhimurium.
    c. Shigella dysenteriae.
    d. Yersinia pestis.

27. A gram negative bacillus on TSI produces Acid/Acid; ornithine and lysine are decarboxylated and both gelatinase and DNase are produced. This organism is most likely:

    a. Enterobacter aerogenes.
    b. Escherichia coli.
    c. Klebsiella oxytoca.
    d. Serratia marcescens.

28. Escherichia coli is an example of a bacterium which is capable of fermenting glucose. If you were to perform the MRVP test on this organism, you would expect the following reaction:

    a. MR (+); VP (+)
    b. MR (-); VP (-)
    c. MR (+); VP (-)
    d. MR (-); VP (+)

29. A non-motile gram negative bacillus is isolated from feces. The biochemical profile is:

    lactose negative
    no hydrogen sulfide produced
    indole positive
    citrate negative

    The organism is most likely a:

    a. Shigella species.
    b. Salmonella species.
    c. Serratia species.
    d. Proteus species.

30. A gram negative bacillus is isolated from a sputum culture. On the EMB plate, it produces mucoid colonies. When inoculated to conventional biochemicals, it gives the following reactions:

TSI	Acid/Acid, gas (+), H_2S(-)
LIA	purple slant, purple butt
MIO	Motility (-) Indol (-) Ornithine (-)
Citrate	Blue color
Urea	Pink color

    This organism is most likely:

    a. Escherichia coli.
    b. Klebsiella pneumoniae.
    c. Proteus rettgeri.
    d. Shigella sonnei.

31. Enterobacteriaceae O antigens may be masked by:

    a. capsular antigens.
    b. somatic antigens.
    c. pili antigens.
    d. flagellar antigens.

32. Dr. Childs sends a stool specimen to the laboratory with a request for the isolation of Yersinia enterocolitica. What should the tech do to ensure the isolation of this organism?

    a. Subject the specimen to heat shock treatment before plating to routine enteric medium AND incubate the plates at 25 C for 24 hours.
    b. Plate the specimen to low selectivity enteric differential media AND incubate the plates at 25 C for 48 hours.
    c. Expose the specimen to cold enrichment procedures prior to plating on routine enteric media AND incubate the plates at 37 C for 24-48 hours.
    d. Plate the specimen to the routine enteric battery AND proceed as with other enteric pathogens.

33. A gram negative bacillus is isolated from the surface of a skin burn. It is found to produce a diffusable green pigment on Mueller-Hinton agar. Further studies of this organism would most likely show it to be:

    a. resistant to most antibiotics and oxidase negative.
    b. susceptible to most antibiotics and oxidase negative.
    c. resistant to most antibiotics and oxidase positive.
    d. susceptible to most antibiotics and oxidase positive.

34. After a 24 hour incubation period and the addition of appropriate reagents, an API strip does not code out. You should:

    a. set up a new API strip.
    b. report the organism most closely matching the biotype number.
    c. reincubate the strip for another 24 hours.
    d. check the purity of the organism and set up a new API strip.

35. A gram negative bacillus is isolated from a stool on MacConkey and SS agar. It has the following biochemical reactions:

TSI	Alk/Acid, H_2S (+), gas (-)
Citrate	positive
Urease	negative
Lysine	negative
Phenylalanine	negative
Motility	positive

What should be done next to identify this organism?

    a. The organism is probably a Salmonella and it should be tested with a Salmonella polyvalent antiserum.
    b. The organism is probably an Arizona and a malonate broth should be set up.
    c. The organism is probably Citrobacter freundii and the ONPG test should be performed.
    d. The organism is a Proteus vulgaris and no further workup need be performed.

36. Which anaerobic organism is described as a long gram negative tapered rod?

    a. Bacteroides species.
    b. Fusobacterium species.
    c. Lactobacillus species.
    d. Propionibacterium species.

37. The species of Clostridium having a distinctive drumstick or racquet-shaped morphology that makes tentative identification possible from a direct gram stain is:

    a. Clostridium botulinum.
    b. Clostridium perfringens.
    c. Clostridium septicum.
    d. Clostridium tetani.

38. Facultative anaerobic bacteria:

    a. require no oxygen.
    b. require carbon dioxide.
    c. require an excess of oxygen.
    d. respire in the presence or absence of oxygen.

39. The catalyst used in the GasPak anaerobic jar contains:

    a. carbon dioxide.
    b. hydrogen.
    c. methylene blue.
    d. palladium.

40. Double-zone hemolysis is an identifying characteristic of:

    a. Clostridium botulinum.
    b. Clostridium perfringens.
    c. Clostridium ramosum.
    d. Clostridium tetani.

41. The presence of sulfur granules composed of aggregates of filamentous organisms seen from an exudate is indicative of:

    a. Actinomyces.
    b. Bifidobacterium.
    c. Eubacterium.
    d. Propionibacterium.

42. A doctor requests an anaerobic culture on a lung abcess. What is the best specimen to collect for a diagnosis?

    a. bronchial washing.
    b. needle aspirate.
    c. nebulized sputum.
    d. transtrachial aspirate.

43. A primary isolation medium for anaerobes would be:

    a. MacConkey agar.
    b. Tergitol agar.
    c. Xylose Lysine Desoxycholate agar.
    d. Schaedler's Blood agar with Vitamin K.

44. A gram negative non-motile bacilli is isolated anaerobically from a blood culture that was hemolyzed and had a foul odor. No growth was observed in the aerobic cultures. These findings are compatible with:

    a. Bacteroides species.
    b. Brucella species.
    c. Clostridium species.
    d. Hemophilus species.

45. Peptococcus is tested for catalase by the same technique as for staphylococci, except that Peptococcus cultures must be:

    a. tested on blood agar only.
    b. tested with a 3% solution of hydrogen peroxide.
    c. tested with a 30% solution of hydrogen peroxide.
    d. exposed to air for one-half hour before testing.

46. The medium of choice to determine the presence of lecithinase produced by Clostridium perfringens is:

    a. Columbia Colistin Naladixic Acid agar.
    b. Cooked Meat Medium.
    c. Egg Yolk Medium.
    d. Kanamycin-Vancomycin agar.

47. Black colonies on Blood agar supplemented with Vitamin K is indicative of:

    a. Bacteroides fragilis.
    b. Bacteroides melaninogenicus.
    c. Fusobacterium fusiforme.
    d. Fusobacterium nucleatum.

48. A gram stain of a local infection of the gums showed many large, thick spirochetes and long, fusiform-like bacilli. Which two organisms, acting synergistically, are producing this infection?

    a. Treponema pinta and Bacteriodes oralis.
    b. Spirillum minus and Eubacterium distorum.
    c. Leptospira pomona and Actinomyces israelii.
    d. Borrelia vincentii and Fusobacterium nucleatum.

49. A diabetic patient is admitted to the hospital with a gaseous foot abscess. Which anaerobic organism is most likely to be the cause of this manifestation?

    a. Bacillus cereus.
    b. Bacteroides fragilis.
    c. Clostridium perfringens.
    d. Fusobacterium nucleatum.

50. A gram stain of a brain abscess exhibits gram negative diplococci. The aerobic culture on chocolate agar shows "No growth" after 48 hours. What organism could be causing this infection?

    a. Bacteroides fragilis.
    b. Neisseria meningitidis.
    c. Peptococcus magnus.
    d. Veillonella parvula.

51. Streptococcus pneumoniae is a:

    a. motile, encapsulated organism.
    b. spore-former.
    c. gram negative diplococcus.
    d. gram positive lancet-shaped diplococcus.

52. Staphylococcus epidermidis is:

    a. catalase negative.
    b. coagulase negative.
    c. mannitol positive.
    d. salt intolerant.

53. Streptococcus pneumoniae produce a green ring around the colonies on blood agar. The greening of the medium is due to:

    a. an alpha lysin.
    b. a gamma lysin.
    c. a lipochrome.
    d. optochin production.

54. Thayer-Martin medium is used as a primary isolation medium for:

    a. Hemophilus influenzae.
    b. Neisseria gonorrhoeae.
    c. Streptococcus pyogenes.
    d. Corynebacterium diptheriae.

55. Most Streptococcus pneumoniae are:

    a. bile insoluble.
    b. alpha hemolytic.
    c. optochin resistant.
    d. oxygen labile.

56. Hemolysis which is described as a zone of partially lysed red cells surrounding a colony and producing a greenish or brown discoloration is called:

    a. alpha.
    b. beta.
    c. gamma.
    d. alpha-prime.

57. In the performance of the coagulase test, oxalated plasma is preferred to citrated plasma because:

    a. it is readily available from the blood bank laboratory.
    b. some bacteria utilize citrate.
    c. oxalate is more readily soluble than citrate.
    d. some bacteria utilize oxalate.

58. All species of the genus Neisseria have the capacity to oxidize:

    a. glucose.
    b. poly-B-hydroxybutyric acid.
    c. para-dimethyl aminobenzaldehyde.
    d. tetramethyl-p-phenylenediamine-HCl

59. The gas that is evolved in a positive catalase test is:

    a. carbon dioxide.
    b. hydrogen.
    c. nitrogen.
    d. oxygen.

60. Which of the following tests would be most useful in identifying Group B beta-hemolytic Streptococci?

    a. bacitracin.
    b. bile solubility.
    c. bile esculin hydrolysis.
    d. sodium hippurate hydrolysis.

61. Which organism is catalase negative?

    a. Staphylococcus sp.
    b. Streptococcus sp.
    c. Micrococcus sp.
    d. Listeria sp.

62. The reagent used in the sodium hippurate hydrolysis test contains:

    a. ferric chloride.
    b. hydrogen peroxide.
    c. sodium chloride.
    d. sodium desoxylcholate.

63. Which of the following tests would be most helpful to identifying Group D beta hemolytic Streptococci?

    a. bacitracin.
    b. bile solubility.
    c. bile esculin hydrolysis.
    d. sodium hippurate hydrolysis.

64. Enterococci are:

    a. bile esculin positive and 6.5% NaCl positive.
    b. bile esculin negative and 6.5% NaCl negative.
    c. bile esculin positive and 6.5% NaCl negative.
    d. bile esculin negative and 6.5% NaCl positive.

65. Which is the best single test for identifying Staphylococcus aureus?

    a. Mannitol fermentation.
    b. Esculin hydrolysis.
    c. Hemolysis.
    d. Coagulase.

66. In females, the best site to culture for the isolation of Neisseria gonorrhoeae is the:

    a. cervix.
    b. rectum.
    c. urethra.
    d. vagina.

67. Which organism is NOT included in the Streptococcus viridans group?

    a. Streptococcus mutans
    b. Streptococcus pyogenes
    c. Streptococcus mitis
    d. Streptococcus sanguis

68. Thayer-Martin medium consists of chocolate agar with the addition of:

    a. NAD.
    b. VCN.
    c. penicillinase.
    d. Factors X and V.

69. Gram positive cocci that occur singly, in pairs, or in irregular clusters belong to the Family which include:

    a. Streptococci.
    b. Enterococci.
    c. Micrococci.
    d. Pneumococci.

70. In the bile solubility test, a positive reaction would appear as:

    a. a zone of inhibition of 15-18 mm.
    b. a blackening of the medium.
    c. clearing or lysis occurring within 5 to 10 minutes.
    d. growth or turbidity after 18-24 hours of incubation.

71. Neisseria gonorrhoeae is best cultivated:

    a. at 37-38°C.
    b. in a GasPak jar.
    c. with an increased oxygen tension.
    d. in a 3-10% CO_2 atmosphere.

72. Hemophilus influenzae is best isolated on:

    a. Bordet-Gengou agar.
    b. Chocolate agar.
    c. Sheep blood agar supplemented with Vitamin K.
    d. Thayer-Martin medium.

73. Which organism is bile soluble, optochin sensitive or can be identified with the Quellung test?

    a. Alpha hemolytic Streptococcus.
    b. Enterococcus.
    c. Gamma hemolytic Streptococcus.
    d. Pneumococcus.

74. Colonies of salt-tolerant Staphylococcus aureus appear on this medium surrounded by a readily visible yellow halo:

    a. Bile esculin medium.
    b. C.A.M.P.
    c. CNA agar.
    d. Mannitol-Salt agar.

75. Which pair of organisms is most easily differentiated on the basis of their gram stain morphology?

    a. Staphylococcus and Micrococcus
    b. Listeria and Corynebacterium
    c. Alpha streptococcus and Beta streptococcus
    d. Staphylococcus and Corynebacterium

76. Sputum cultures are inoculated onto Sheep blood agar and Colistin Naladixic Acid (CNA) agar, in addition to other media. What purpose does the CNA agar serve?

    a. It provides a richer medium for gram positive organisms.
    b. It inhibits gram negative rods and permits the growth of gram positive cocci.
    c. It separates Staphylococci from Streptococci.
    d. It permits the growth of the more fastidious gram negative bacilli.

77. Group D streptococci will not grow on MacConkey agar because the medium contains:

    a. neutral red.
    b. lactose.
    c. colistin.
    d. bile salts.

78. Which pair of organisms is most easily differentiated by colonial morphology when grown on sheep blood agar incubated in a candle jar?

    a. Corynebacterium diptheriae and Erysipelothrix insidiosa.
    b. Listeria monocytogenes and Streptococcus agalactiae.
    c. Neisseria meningitidis and Neisseria lactamicus.
    d. Streptococcus pyogenes and Staphylococcus aureus.

79. A gram negative bacilli grows on chocolate agar and rabbit blood agar, but does not grow on sheep blood agar or MacConkey agar. The organism displays "satellitism" with Staphylococcus aureus on sheep blood agar but not on plain nutrient agar. Which statement is true concerning this organism?

    a. It requires X factor and not V factor.
    b. It requires V factor and not X factor.
    c. It requires both X and V factors.
    d. It requires neither X nor V factors.

80. Which group of streptococci, when grown on sheep blood agar in close proximity to a beta toxin producing strain of Staphylococcus, produces a peculiar lytic phenomenon referred to as "arrow head" hemolysis?

    a. A
    b. B
    c. D
    d. G

81. Which organism would produce the following reactions:

Gram positive cocci, arranged in masses
Coagulase negative
Catalase positive
Mannitol negative
Glucose negative

a. Staphylococcus aureus.
b. Staphylococcus epidermidis.
c. Streptococcus pyogenes.
d. Micrococcus tetragenes.

82. Which of the following statements is NOT true concerning Neisseria gonorrhoeae?

a. It grows well on plain chocolate agar.
b. It grows well on Transgrow medium.
c. It utilizes glucose and maltose.
d. It is cytochrome oxidase positive.

83. All of the following are true concerning Branhamella catarrhalis EXCEPT that it:

a. is normal flora in the respiratory tract.
b. is oxidase positive.
c. utilizes dextrose and sucrose.
d. was formerly called Neisseria catarrhalis.

84. A gram positive lancet-shaped organism found on a gram stained smear of an ear culture is suggestive of:

a. Micrococcus sp.
b. Acinetobacter sp.
c. Streptococcus sp.
d. Listeria sp.

85. All of the following are true concerning a Quellung reaction EXCEPT that it:

a. is the most accurate test for the identification of pneumococcal types.
b. is also called a capsular swelling reaction.
c. is performed only on 24 hour cultures of pneumococci.
d. is a microscopic procedure.

86. A Gram stain performed on a cervical smear showed gram negative intracellular diplococci. The organism will:

a. be oxidase negative.
b. grow on chocolate agar containing VCN.
c. grow on sheep blood agar in CO_2 at 37°C.
d. oxidize glucose and maltose.

87. Hemophilus hemolyticus and beta hemolytic Streptococcus can have similar morphology on rabbit blood agar leading to confusion when screening blood plates for Streptococci. To eliminate this problem a technologist should:

    a. add crystal violet to the medium which would inhibit the Hemophilus hemolyticus.
    b. ignore the beta hemolytic colonies on the blood plates.
    c. perform a gram stain on all beta hemolytic colonies.
    d. use sheep blood agar which inhibits hemolysis of H. hemolyticus.

88. You have isolated a gram positive coccus which shows morphologic and colonial characteristics typical of Staphylococcus aureus. The result of a slide test for coagulase using fresh rabbit plasma is negative. You next step would be to:

    a. perform a tube coagulase test.
    b. repeat the slide coagulase test.
    c. report as Staphylococcus epidermidis.
    d. set up a 6.5% NaCl broth culture.

89. You have isolated an organism from a nasopharyngeal culture which you suspect is a Neisseria. You inoculate CTA sugars and after 24 hours notice that acid is produced in glucose, maltose and lactose tubes but no acid is produced in the sucrose tube. You should:

    a. reincubate the sugars for an additional 24 hours.
    b. report as positive for Neisseria gonorrhoeae.
    c. report as positive for Neisseria meningitidis.
    d. check for purity by gram staining the sugars before proceeding further.

90. A physician has sent a sputum specimen to the laboratory. The gram stain shows many gram positive cocci in chains and pairs. Many small alpha hemolytic colonies are seen on the sheep blood agar plate. It is not clear, however, whether this organism is pneumococcus or an alpha hemolytic streptococcus. Which test would make this differentiation?

    a. bacitracin.
    b. catalase.
    c. esculin hydrolysis.
    d. optochin.

91. Loeffler's medium is used as a primary isolation medium for:

    a. Pasteurella multocida.
    b. Listeria monocytogenes.
    c. Corynebacterium diphtheriae.
    d. Bordetella pertussis.

92. The best procedure to differentiate Listeria monocytogenes from Corynebacterium species is:

    a. a gram stain.
    b. motility test.
    c. a catalase test.
    d. fermentation of glucose.

93. Characteristic pitting on a blood agar plate is indicative of:

    a. Mycoplasma pneumoniae.
    b. Eikinella corrodens.
    c. Chlamydia trachomatis.
    d. Campylobacter fetus.

94. A patient was diagnosed as having bacterial meningitis. No organisms were seen on a direct Gram stain of the CSF. A pure culture of a small translucent, beta-hemolytic organism was isolated from blood and CSF specimens. A gram stain revealed tiny gram positive bacilli having a tumbling motility at room temperature incubation. What is the most likely etiological agent?

    a. Streptococcus pyogenes.
    b. Pasteurella multocida.
    c. Listeria monocytogenes.
    d. Hemophilus hemolyticus.

95. A patient has been on I.V. therapy for 10 days and develops sepsis. Three successive blood cultures grow a gram positive, fat bacillus that appears on blood agar incubated aerobically as large, flat, dull colonies with a typical ground-glass appearance. The organism is most likely:

    a. Corynebacterium sp.
    b. Erysipilothrix sp.
    c. Bacillus sp.
    d. Listeria sp.

96. The characteristic that separates Group IV Mycobacterium from the other Mycobacterium is its:

    a. catalase production.
    b. growth rate.
    c. niacin reaction.
    d. pigment production within 7 days.

97. A patient is suspected of having miliary tuberculosis. What is the specimen of choice?

a. CSF
b. feces
c. urine
d. sputum

98. Using the "cold" modification of the Ziehl-Neelson stain, the Mycobacteria will appear as:

a. blue bacilli against a pink background.
b. red bacilli against a blue background.
c. yellow bacilli against a black background.
d. green bacilli against a red background.

99. An acid-fast bacillus has been isolated from the sputum of a patient suspected of having tuberculosis. The organism was colorless when grown in the dark but turned yellow after exposure to light for 30 minutes. This organism most likely belongs to the:

a. rapid growers.
b. non-photochromogens.
c. scotochromogens.
d. photochromogens.

100. In processing routine sputum specimens for Mycobacteria, it is advisable to:

a. decontaminate with 5% oxalic acid.
b. decontaminate with 4% NaOH.
c. digest the mucus with 2% albumin.
d. digest the mucus with vigorous vortexing.

101. Blood cultures are best collected:

a. after admission to the hospital.
b. after administration of antimicrobial therapy.
c. during a febrile episode.
d. three times a day.

102. Which of the following specimen sources is most suitable for anaerobic culture?

a. urine.
b. sputum.
c. synovial fluid.
d. vaginal swab.

103. What percentage of blood is generally used in making blood agar plates?

a. 2%
b. 5%
c. 10%
d. 20%

104. In preparing media, at what temperature does agar solidify?

a. 32°C
b. 42°C
c. 56°C
d. 80°C

105. What is the minimum number of days that a routine blood culture should be incubated before reporting out as "No growth"?

a. 3
b. 7
c. 14
d. 21

106. Selective media is best defined as media that can:

a. enhance the growth of a specific group of bacteria.
b. differentiate two organism based on their color reactions.
c. inhibit the growth of certain organisms.
d. support the growth of fastidious organisms.

107. The indicator generally used to monitor anaerobic conditions during anaerobic incubation is:

a. bromthymol blue.
b. crystal violet.
c. methylene blue.
d. pallidium.

108. A medium that must be stored at room temperature is:

a. GN broth.
b. Selenite broth.
c. S-F broth.
d. Thioglycollate broth.

109. The counterstain used in the gram stain procedure is:

a. Crystal violet.
b. Gentian violet.
c. Lugol's iodine.
d. Safranin.

110. It is sometimes necessary to examine certain microorganisms in the living state. One method that can be used for this is the:

a. acid-fast stain.
b. dry mount technique.
c. hanging drop method.
d. methylene blue stain technique.

111. The most suitable transport system for a culture of a wound specimen is a sterile swab in:

a. cooked meat medium.
b. a sterile tube.
c. Stuart's medium.
d. tryptic soy broth.

112. Bacteriology plates are incubated in an inverted position to:

a. keep the organism from spreading.
b. permit the air to circulate properly.
c. prevent excess condensation on the colonies.
d. prevent light from affecting the colony growth.

113. Isolation techniques include all of the following EXCEPT:

a. broth culture.
b. pour plate method.
c. streak plate method.
d. calibrated loop technique.

114. Bacteria found in a clean-voided urine is considered to be significant if present in the following amount or greater:

a. 1,000 col/ml
b. 10,000 col/ml
c. 100,000 col/ml
d. 1,000,000 col/ml

115. Which method does NOT provide an anaerobic atmosphere?

a. Brewer Jar
b. Candle Jar
c. GasPak Jar
d. Glove Box

116. Bacterial meningitis is accompanied by a cerebrospinal fluid that:

a. is purulent and shows a cell counter greater than 1000 WBC/mm^3
b. shows a reduced protein determination.
c. has an elevated glucose concentration.
d. shows a predominance of red blood cells.

117. The procedure manual calls for the subculturing of the Selenite broth from stool cultures to be plated to EMB and Hektoen Enteric media. However, you have no Hektoen medium. You can substitute:

    a. CNA agar.
    b. MacConkey agar.
    c. XLD agar.
    d. PEA agar.

118. A gram positive diplococci is found on a gram stained smear of a vaginal culture. An identical specimen is sent for repeat smear and gram stain the same day. This smear result was gram negative diplococci. The next step would be to:

    a. change all stains and reagents.
    b. repeat the gram stain a third time.
    c. request a new specimen.
    d. stain a control smear with the existing stain.

119. The mechanism of action of penicillin is interference with:

    a. membrane function.
    b. cell wall synthesis.
    c. protein synthesis.
    d. nucleic acid synthesis.

120. The tetracyclines:

    a. are called "broad spectrum" antibiotics.
    b. are derived from chloramphenicol.
    c. are effective only against gram positive bacteria.
    d. have dissimilar basic molecular structures.

121. The medium used in antibiotic disc diffusion procedures is standardized at a pH of:

    a. 6.5 to 6.6
    b. 6.8 to 7.0
    c. 7.0 to 7.2
    d. 7.2 to 7.4

122. The agar most frequently used for susceptibility testing is:

    a. Brain Heart Infusion.
    b. Trypticase Soy.
    c. Mueller-Hinton.
    d. Sheep Blood.

123. When manually dispensing antibiotic discs it is essential to use:

    a. flamed forceps.
    b. more than one type of media.
    c. both high and low concentration discs.
    d. cold media directly from the refrigerator.

124. An antibiotic susceptibility report is termed resistant if:

a. There is a zone of growth inhibition around the disc.
b. There is no zone of inhibition seen.
c. The microorganism does not grow up to the disc.
d. The zone of inhibition is less than that indicated for the particular antibiotic.

125. Disc diffusion susceptibility plates should be read:

a. 30 minutes after incubation.
b. 4-8 hours after incubation.
c. 18-20 hours after incubation.
d. 24-48 hours after incubation.

126. Antibiotic discsshould be stored in the refrigerator to prevent deterioration due to:

a. humidity.
b. contamination.
c. evaporation.
d. out-dating.

127. Minimum inhibitory concentration (MIC) is defined as:

a. the minimum concentration of antibiotic required to inhibit an organism.
b. the maximum concentration of antibiotic required to kill an organism.
c. the minimum concentration of antibiotic required to kill an organism.
d. the maximum concentration of antibiotic required to inhibit an organism.

128. The most commonly used method for suseptibility testing of microorganisms is:

a. agar overlay procedure.
b. disc diffusion method.
c. replicate plate method.
d. serial dilution method.

129. In the single disc Kirby Bauer method of sensitivity testing, the size of the zone of inhibition used to indicate sensitivity is determined by correlating the zone size with the:

a. antibiotic content of the disc.
b. clinical response of the patient.
c. minimum bactericidal concentration.
d. minimum inhibitory concentration.

130. Which organism should NOT be tested for susceptibility to antibiotics by using the Kirby Bauer disc method?

   a. Escherichia coli
   b. Neisseria gonorrhoeae
   c. Pseudomonas aeruginosa
   d. Staphylococcus aureus

131. Susceptibility testing should be performed:

   a. on isolates that are known to be highly susceptible.
   b. routinely on all clinically significant isolates.
   c. only on specimens from normally sterile body fluids or tissues.
   d. when the clinical picture warrants the use of secondary drugs of choice.

132. A quantitative estimation of antibiotic sensitivity of an organism may be most accurately obtained by:

   a. determining the size of the zone of inhibition.
   b. performing serial dilutions of the antibiotic.
   c. testing growth of the organism in a single tube of medium containing the antibiotic.
   d. using sensitivity discs containing three concentrations of the antibiotic.

133. Direct susceptibility testing may be considered appropriate only from which body site?

   a. blood.
   b. sputum.
   c. urine.
   d. wound.

134. Which factor would affect the results of a disc diffusion sensitivity test by making the organism appear more resistant?

   a. a low pH of the medium.
   b. high salt concentration of the medium.
   c. too little agar in the plate.
   d. too many organisms in the inoculum.

135. What additional information, besides susceptibility, can sometimes be obtained from antibiotic susceptibility testing?

   a. proof of toxigenicity.
   b. possible misidentification of the isolate.
   c. two antibiotics appear to be acting synergistically.
   d. whether the organism is from an environmental or human source.

136. Contaminated materials can be decontaminated in an autoclave with 15 PSI, at 121°C for:

   a. 10 minutes.
   b. 15 minutes.
   c. 30 minutes.
   d. 60 minutes.

137. Oversterilization of media should be avoided in order to prevent:

   a. browning of the cotton plugs.
   b. blowing of cotton plugs.
   c. decomposition of ingredients in the media.
   d. evaporization of the media.

138. Etiology refers to the study or theory:

   a. of the clinical manifestations of any disease.
   b. of the pathogical manifestations of any disease.
   c. of all of the manifestations of any disease.
   d. of the causation of any disease.

139. A secondary infection:

   a. is less important than a primary infection.
   b. does not cause any detectable symptoms.
   c. is one that follows a primary infection.
   d. is more important than a primary infection.

140. Nosocomial infections are:

   a. present on primary hospital admission.
   b. incubating on hospital admission followed by overt disease.
   c. acquired during the hospital stay.
   d. only those infections spread from the hospital to the community.

141. Each batch of media that is made should be tested for sterility by:

   a. using spore strips in the autoclave.
   b. using stock cultures with known biochemical reactions.
   c. examining uninoculated media after incubation.
   d. visual inspection after the media has cooled down.

142. Calibrated inoculating loops that are rough or irregular prevent the accurate dispensing of specimen quantity. These loops should be:

   a. recalibrated.
   b. sent to the manufacturer for repair.
   c. reshaped.
   d. replaced.

143. In the microbiology laboratory, pipetting by mouth should:

a. be used only for non-contaminated liquids.
b. be used only with water.
c. never be allowed.
d. be used only for making media.

144. The active proteins of a bacterial cell are denatured by all of the following chemical agents EXCEPT:

a. acids.
b. acetone.
c. alkalis.
d. basic dyes.

145. The use of plain soap and water for handwashing by hospital personnel is:

a. sufficient for all occasions.
b. improper since antiseptic agents should be used.
c. sufficient for some occasions, but antiseptics are more highly recommended.
d. not recommended since the water may be contaminated.

146. Routine hospital surveys for nasopharyngeal carriers of Staphylococcus aureus are:

a. essential so that carriers in critical areas may be either reassigned duties or treated with antibiotics.
b. essential to establish a baseline in a particular hospital in the event of a subsequent outbreak.
c. essential because of medical-legal implications.
d. unreliable, impractical and not warranted.

147. The temperature range for microbiology refrigerators and incubators should be _____^{o}C and _____^{o}C respectively.

a. 0-10; 25-35
b. 10-20; 35-37
c. 2-8; 34-36
d. 0-4; 30-35

148. Microbiology spills should be cleaned immediately with:

a. alcohol.
b. liquid soap.
c. phenol.
d. betadine.

149. A set of stock cultures is maintained in the laboratory to check all media and reagents. To check media and reagents for positive and negative reactions, which combination if appropriate?

a. bile-solubility--Streptococcus pneumoniae, alpha hemolytic streptococcus Group D.
b. catalase--Staphylococcus aureus, Micrococcus.
c. hydrogen sulfide production--Salmonella and Proteus mirabilis.
d. oxidase--Pseudomonas aeruginosa, Neisseria gonorrhoeae.

150. The best method to quality control a wound specimen that is received would be:

a. to plate stock organisms to a similar set up of media.
b. to gram stain the specimen and correlate the results with the growth obtained.
c. to perform daily quality control on all reagents and equipment utilized.
d. by proficiency testing the personnel periodically.

CONTINUED ON NEXT PAGE

151. Most medically important fungi belong to the classification:

a. Mastigomycotina.
b. Zygomycotina.
c. Ascomycotina.
d. Deuteromycotina.

152. Hyphae with walls between cells are called:

a. echinulate.
b. floccose.
c. septate.
d. mycelium.

153. Specimens for fungal culture should be incubated at:

a. 45°C and 20°C.
b. 37°C and 20°C.
c. 37°C.
d. 20°C.

154. Endothrix invasion of hair means that fungal hyphae and spores are:

a. growing inside the hair.
b. penetrating the hair perpendicularly.
c. attached to the outside of the hair.
d. non-invasive.

155. The most common antibiotics added to media for fungus culture are:

a. amphotericin and penicillin.
b. vancomycin, colistin, nystatin.
c. cycloheximide and chloramphenicol.
d. streptomycin and penicillin.

156. Final identification of yeast is usually made by:

a. carbohydrate assimilation.
b. pigment production.
c. septate hyphae production.
d. lactophenol cotton blue staining.

157. The term used for brownish colored hyphae as found in Cladosporium type fungi is:

a. geophilic.
b. dematiaceous.
c. melanogenic.
d. rusty.

158. Coccidioidomycosis is a fungus infection acquired by inhaling:

a. blastospores.
b. arthrospores.
c. chlamydospores.
d. microconidia.

159. Actinomyces israelii is:

a. urease positive.
b. anaerobic.
c. acid-fast.
d. gram negative.

160. Tinea capitis is caused by:

a. Actinomyces israelii.
b. Epidermophyton floccosum.
c. Microsporum audouinii.
d. Pityrosporum furfur.

161. A very mucoid pink yeast is:

a. Candida krusei.
b. Cryptococcus neoformans.
c. Nocardia asteroides.
d. Rhodotorula species

162. Macroscopic morphology of a dimorphic fungus may be described as:

a. mold form at 37°C, yeast form at 20°C.
b. mold form at both 37°C and at 20°C.
c. mold form at 20°C, yeast form at 37°C.
d. yeast form at both 20°C and at 37°C.

163. Thick walled terminal spores produced in times of poor conditions on corn meal agar are called:

a. blastospores.
b. chlamydospores.
c. thallospores.
d. germ tubes.

164. The purpose of lactophenol cotton blue stain is to:

a. dissolve hyphae and stain the spores.
b. dissolve tissue and fat.
c. kill fungus and outline structures.
d. preserve living fungus.

165. Identification of Candida albicans is based on the demonstration of:

a. arthrospores and sporangiospores.
b. germ tubes and chlamydospores.
c. macroconidia and microconidia.
d. sporangiospores and septate hyphae.

166. The spread of Cryptococcosis is frequently associated with exposure to:

a. contaminated fish.
b. dry soil.
c. specific chemicals.
d. pigeon excreta.

167. An endogenous fungi can cause draining sinuses in the jaw and neck after oral surgery. The disease is called:

a. Actinomycosis.
b. Cryptococcosis.
c. Nocardiosis.
d. Sporotrichosis.

168. Microsporum sp. can be differentiated from Trichophyton sp. because:

a. Microsporum produces large spiny thick-walled macroconidia.
b. Microsporum produces club-shaped macroconidia.
c. Trichophyton produces spiny thick-walled macroconidia.
d. Trichophyton do not produce microconidia.

169. A dimorphic fungus causing an influenzae-like infection produces characteristic tuberculate macroconidia in the mold phase. It is probably:

a. Blastomyces dermatitidis.
b. Coccidioides immitis.
c. Histoplasma capsulatum.
d. Sporothrix schenckii.

170. A organism isolated from a pulmonary infection grows as an orange-yellow colony on Sabouraud's media. It is a filamentous organism that is partially acid-fast. The organism is probably:

a. Coccidioides immitis.
b. Klebsiella pneumoniae.
c. Mycobacterium tuberculosis.
d. Nocardia asteroides.

171. The relationship between two organisms in which one is benefited and the other is neither benefited nor injured is known as:

a. parasitism.
b. symbiosis.
c. commensalism.
d. facultatism.

172. A host in which the parasite usually does not cause disease and may or may not continue to develop is known as a(n):

a. incidental host.
b. intermediate host.
c. infected host.
d. vector.

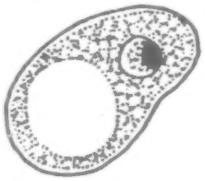
173. Hookworm are transmitted to man through:

a. ingestion.
b. inhalation of cysts.
c. penetration of the skin by vector bite.
d. penetration of the skin by larvae..

174. Of all the intestinal amoebae, which one is considered pathogenic to man?

a. Entamoeba gingivalis.
b. Entamoeba coli.
c. Endolimax nana.
d. Entamoeba histolytica.

175. Identify the parasite represented in this picture:



a. Iodamoeba butschlii cyst.
b. Iodamoeba butschlii trophozoite.
c. Endolimax nana cyst.
d. Endolimax nana trophozoite.

176. The number of nuclei seen in Entamoeba coli cysts range from:

a. 1-4.
b. 1-8.
c. 4-6.
d. 4-12.

177. The flagellate demonstrating two large sucking discs in the trophozoite stage is:

  a. Balantidium coli.
  b. Chilomastix mesneli.
  c. Giardia lamblia.
  d. Trypanosoma cruzii.

178. The flagellate causing venerally transmitted vaginitis and urethritis is:

  a. Trichomonas hominis.
  b. Trichomonas vaginalis.
  c. Trichomonas tenax.
  d. Giardia lamblia.

179. The trypanosomal stage of Leishmania donovani exhibited in the reticuloendothelial tissue is the:

  a. promastigote.
  b. amastigote.
  c. epimastigote.
  d. non-mastigote.

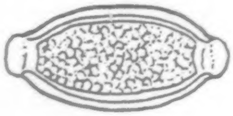
180. Schuffner's dots and enlarged infected red blood cells are characteristically associated with:

  a. Toxoplasma gondii.
  b. Pneumocystis carinii.
  c. Plasmodium vivax.
  d. Plasmodium falciparum.

181. The parasite diagnosed by use of the Scotch tape test is:

  a. Ascaris lumbricoides.
  b. Enterobius vermicularis.
  c. Necator americanus.
  d. Trichinella spiralis.

182. The roundworm having a bile-stained ova resembling a Chinese lantern (pictured below) is:



  a. Ascaris lumbricoides.
  b. Enterobius vermicularis.
  c. Ancylostoma duodenale.
  d. Trichuris trichiura.

183. The sheathed microfilaria with two nuclei visible at the tip of the tail

a. Loa Loa.
b. Leishmania tropica.
c. Brugia malayi.
d. Trypanosoma gambiense.

184. The cestode with a long sucking groove in the scolex is:

a. Taenia solium.
b. Hymenolepsis diminuta.
c. Diphyllobothrium latum.
d. Echinococcus granulosus.

185. The schistosoma with an ova having a prominant lateral spike:

a. hematobium.
b. japonicum.
c. mansoni.
d. westermani.

186. The method of choice for screening for plasmodia is:

a. thick blood film.
b. thin blood film.
c. urine sedimentation.
d. formalin-ether concentration.

187. All of the following are advantages of adding a preservative to stool specimens EXCEPT:

a. kills the organisms.
b. preserves most internal structures.
c. convenient for shipping specimens.
d. enhances the motility of trophozoites.

188. A child ingesting food contaminated with feces may be subject to infection with all of the following parasites EXCEPT:

a. Enterobius vermicularis.
b. Giardia lamblia.
c. Entamoeba histolytica.
d. Necator americanus.

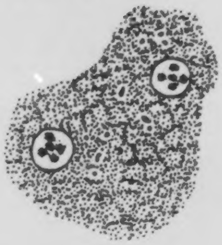
189. Ingestion of inadequately cooked pork increases the risk of infection with:

a. Taenia saginata.
b. Trichinella spiralis.
c. Diphyllobothrium latum.
d. Echinococcus granulosus.

190. A small, oval protozoan cyst with smooth cytoplasm and 4 nuclei containing blot-like karyosomes can most likely be identified as:

a. Iodamoeba butschlii.
b. Chilomastix mesneli.
c. Endolimax nana.
d. Dientamoeba fragilis.

191. A trichrome stain revealed the organism pictured below. It exhibits fragmented karyosomes, no visible peripheral chromatin and has a very vacuolated cytoplasm. This organism is most likely:



a. Entamoeba hartmanni.
b. Entamoeba coli.
c. Endolimax nana.
d. Dientamoeba fragilis.

192. Chilomastix mesneli is identified in the stool of a diarrhetic patient. What is the significance of this identification by the laboratory?

a. It is probably a contaminant from the laboratory tap water.
b. The organism is not considered pathogenic but indicates contact with contaminated food or water.
c. The organism is a yeast commonly confused with intestinal protozoa.
d. The organism is a cause of amoebic dysentery.

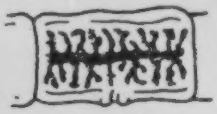
193. Fifty percent of the red blood cells in a thin blood smear contain ring forms of a Plasmodium. No maturing schizonts or gametocytes are seen. The patient is experiencing paroxysms which occur at irregular intervals. The causative organism is most likely:

a. Plasmodium vivax.
b. Plasmodium falciparum.
c. Plasmodium ovale.
d. Plasmodium malariae.

194. The female of this worm lays up to 200,000 eggs per day which are readily detected in the stool by their thick mamilated shell. The organism is:

a. Trichuris trichiura.
b. Necator americanus.
c. Ascaris lumbricoides.
d. Strongyloides stercoralis.

195. During the treatment of abdominal obstruction due to a tapeworm, a patient passed a segment of proglottids. Each gravid proglottid in the segment contains 7-12 uterine branches as pictured below. The tapeworm can be identified as:



Proglottid

a. Taenia solium.
b. Diphyllobothrium latum.
c. Dipylidium caninum.
d. Hymenolepsis nana.

196. The pathogenic flagellate which infects the duodenum and may frequently be recovered in duodenal washings is:

a. Strongyloides stercoralis.
b. Giardia lamblia.
c. Chilomastix mesnili.
d. Trichomonas hominis.

197. A stool left at room temperature for 4 hours containing Hookworm ova could later be incorrectly identified as:

a. Ancylostoma duodenale.
b. Ascaris lumbricoides.
c. Necator americanus.
d. Strongyloides stercoralis.

198. A technician examines 2 consecutive stool specimens from a patient for ova and parasites. In stool #1, amoebic trophozoites are found. In stool #2, many amoebic cysts are seen, The most probable explanation is:

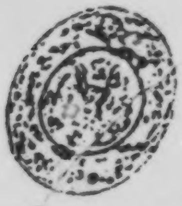
a. One stool was mislabelled and could belong to another patient.
b. The organism is becoming more virulent.
c. The first stool was watery, the second was formed.
d. The second stool was improperly stained.

199. On a direct wet preparation of a diarrhetic stool, an organism is identified as an amoeba. The next step should be to:

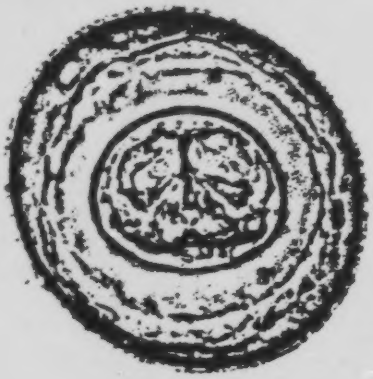
a. perform a trichrome stain for identification.
b. report as positive for amoebic dysentery.
c. report as Entamoeba histolytica.
d. request a repeat specimen for confirmation.

200. The two structures below were seen on an iodine preparation of a concentrated stool specimen:

I.



II.



a. I is an artifact,
   II is Hymenolepsis ovum.
b. I and II are both Diphyllobothrium ova.
c. I is an artifact,
   II is a hydatid sand.
d. I and II are both Hymenolepsis ova.

THE END

MLT - B

1. Which member of the Enterobacteriaceae does not possess a flagella?

   a. Escherichia coli.
   b. Proteus mirabilis.
   c. Salmonella typhimurium.
   d. Shigella sonnei.

2. An enrichment broth used commonly to suppress the growth of coliforms and enhance the chance of isolating Salmonella and Shigella from stool specimens is:

   a. Campy-thio broth.
   b. Selenite broth.
   c. Thioglycollate broth.
   d. Trypticase Soy broth.

3. The Voges-Proskauer test determines the:

   a. decarboxylation of an amino acid.
   b. fermentation of glucose.
   c. formation of indol.
   d. production of acetylmethylcarbinol.

4. Which test can be used to detect beta-galactosidase?

   a. optochin.
   b. oxidase.
   c. ONPG.
   d. DNase.

5. The decarboxylation of ornithine in a Moeller broth tube will result in a color change of:

   a. red to yellow.
   b. yellow to red.
   c. purple to yellow.
   d. purple to purple.

6. The optimal temperature to demonstrate motility of Yersinia enterocolitica is:

   a. 4°C.
   b. 25°C.
   c. 37°C.
   d. 42°C.

7. A gram negative bacilli which usually produces a metallic sheen on Eosin-Methylene Blue agar is:

   a. Escherichia coli.
   b. Klebsiella pneumoniae.
   c. Proteus mirabilis.
   d. Yersinia enterocolitica.

8. The colonial morphology of a non-lactose fermenter on selective enteric media is:

   a. pink and mucoid.
   b. colorless and transparent.
   c. metallic sheen.
   d. yellow and dry.

9. Which member of the Enterobacteriaceae may produce red pigmented colonies on blood agar?

   a. Edwardsiella tarda.
   b. Enterobacter sakazakii.
   c. Pseudomonas aeruginosa.
   d. Serratia marcescens.

10. Which Enterobacteriaceae is always a non-lactose fermenter?

   a. Citrobacter freundii.
   b. Enterobacter aerogenes.
   c. Escherichia coli.
   d. Shigella flexneri.

11. Which reaction would be most useful to distinguish Proteus species from Providencia species?

   a. lysine decarboxylation.
   b. phenylalanine deamination.
   c. glucose fermentation.
   d. urease hydrolysis.

12. The IMViC reaction for Escherichia coli is:

   a. - - + +
   b. - + - +
   c. + - + -
   d. + + - -

13. During the first week of typhoid fever, the best specimen for the isolation of Salmonella typhi is:

    a. blood.
    b. sputum.
    c. stool.
    d. urine.

14. A useful test for separating organisms of the Enterobacteriaceae from most of the Pseudomonads is by the detection of:

    a. alkaline phosphatase.
    b. collagenase.
    c. cytochrome oxidase.
    d. DNase.

15. The characteristic most helpful in differentiating between Enterobacter species and Serratia species is:

    a. DNase production.
    b. hydrogen sulfide production.
    c. indole production.
    d. urea hydrolysis.

16. The primary mode of transmission of diseases due to Salmonella and Shigella is by:

    a. inhalation.
    b. bite of an insect.
    c. droplet infection.
    d. fecal-oral route.

17. The complex antigens of the Genus Salmonella have been documented by:

    a. Bordet and Loeffler.
    b. Ewing and Edwards.
    c. Gable and Lombard.
    d. Kauffman and White.

18. The diagnosis of urinary tract infections in an untreated patient generally is made when bacterial colony counts exceeding 10^5 org./ml are obtained in specimens collected by:

    a. suprapubic aspiration.
    b. syringe into an indwelling catheter collection system.
    c. clean-catch midstream collection.
    d. urethral catherization.

19. Each urine specimen received in the laboratory should be plated to EMB agar (or MacConkey agar) and:

    a. CNA agar.
    b. SS agar.
    c. Anaerobic blood agar.
    d. Sheep blood agar.

20. A dilute suspension of Klebsiella pneumoniae is mixed with equal quantities of type-specific Klebsiella antiserum and then examined microscopically for the presence of a capsule. This is an example of a:

    a. Naegler's reaction.
    b. Elek's reaction.
    c. Quellung reaction.
    d. CAMP reaction.

21. For the quality control testing of O-F glucose media, a suitable positive control to detect an oxidative reaction only would be:

    a. Escherichia coli.
    b. Pseudomonas aeruginosa.
    c. Alcaligenes fecalis.
    d. Citrobacter diversus.

22. A gram negative bacillus produces a purple slant and yellow butt on Lysine Iron Agar (LIA). What does this indicate?

    a. glucose fermentation is negative.
    b. lysine deamination is positive.
    c. lysine decarboxylation is negative.
    d. hydrogen sulfide is positive.

23. The TSI reaction of a gram negative bacilli is alkaline slant and alkaline butt. Which carbohydrate has been fermented?

    a. glucose only.
    b. glucose, lactose but not sucrose.
    c. glucose, lactose and sucrose.
    d. neither glucose, lactose or sucrose.

24. A gram negative bacillus appears as a colorless colony on EMB agar and produces an alkaline slant and acid butt on a KIA (Kligler's Iron Agar) after 24 hours of incubation. Which of the following sugars does this organism ferment?

    a. dextrose only.
    b. dextrose and lactose.
    c. dextrose and glucose.
    d. dextrose and sucrose.

25. Colonies that are green without black centers on Hektoen Enteric Agar could be:

    a. Escherichia coli.
    b. Salmonella typhimurium.
    c. Shigella dysenteriae.
    d. Yersinia pestis.

26. A gram negative swarming bacillus is found on a blood agar plate. Which would be true? It is:

    a. urease (-); phenylalanine deaminase (+); H_2S (-).
    b. urease (+); phenylalanine deaminase (+); H_2S (+).
    c. urease (+); phenylalanine deaminase (-); H_2S (+).
    d. urease (-); phenylalanine deaminase (-); H_2S (-).

27. A bacteria is found to have the following characteristics: it is a gram negative rod, lactose negative, phenylalanine-negative, oxidase negative and urease positive. It does not produce hydrogen sulfide on TSI agar and it is only motile at room temperature. The bacterium is most likely:

    a. Citrobacter diversus.
    b. Edwardsiella tarda.
    c. Enterobacter cloacae.
    d. Yersinia enterocolitica.

28. A gram negative bacilli isolated from urine is found to be lactose negative, urea positive, indol negative, citrate positive and hydrogen sulfide positive. The organism is most likely:

    a. Proteus vulgaris.
    b. Proteus mirabilis.
    c. Morganella (Proteus) morganii.
    d. Providencia (Proteus) rettgeri.

29. A gram negative bacillus is isolated on a Hektoen Enteric agar plate. The biochemical reactions are:

TSI	Acid/Acid with H_2S
LIA	Alk/Acid with H_2S
Indol	negative
Citrate	positive
Ornithine	positive
Phenylalanine	negative
Urease	negative

The organism is most likely:

    a. Citrobacter freundii.
    b. Edwardsiella tarda.
    c. Escherichia coli.
    d. Salmonella typhimurium.

30. The Vi antigen of Salmonella typhi is a(n):

    a. K antigen.
    b. O antigen.
    c. H antigen.
    d. F antigen.

31. Enterobacteriaceae O antigens may be masked by:

    a. capsular antigens.
    b. somatic antigens.
    c. pili antigens.
    d. flagellar antigens.

32. Dr. Childs sent a stool specimen to the laboratory with a request for the isolation of Yersinia enterocolitica. What should the tech do to ensure the isolation of this organism?

    a. Subject the specimen to heat shock treatment before plating to routine enteric medium and incubate the plates at 25°C for 24 hours.
    b. Plate the specimen to low selectivity enteric differential media and incubate the plates at 25°C for 48 hours.
    c. Expose the specimen to cold enrichment procedures prior to plating on routine enteric media and incubate the plates at 37°C for 24 to 48 hours.
    d. Plate the specimen to the routine enteric battery and proceed as with other enteric pathogens.

33. A gram negative bacillus is isolated from the surface of a skin burn. It is found to produce a diffusable green pigment on Mueller-Hinton agar. Further studies of this organism would most likely show it to be:

    a. oxidase negative and sensitive to most antibiotics.
    b. oxidase negative and resistant to most antibiotics.
    c. oxidase positive and sensitive to most antibiotics.
    d. oxidase positive and resistant to most antibiotics.

34. A lactose negative gram negative bacillus is isolated from a stool specimen with the following biochemical reactions:

TSI	Alk/Acid with no gas, H_2S (-)
indol	positive
citrate	negative
urease	negative
lysine	negative
ornithine	negative
phenylalanine	negative

The next step you should take is to:

a. report out as "Anaerogenic Escherichia coli isolated."
b. report out as "Shigella species isolated".
c. repeat the biochemical tests.
d. type the organism with Shigella polyvalent O antisera.

35. A gram negative bacillus is isolated from a stool on MacConkey and SS agar. It has the following biochemical reactions:

TSI	Alk/Acid with no gas, H_2S (+)
citrate	positive
urease	negative
lysine	negative
phenylalanine	negative
motility	positive

What should be done next to identify this organism? The organism is:

a. probably a Salmonella and it should be tested with Salmonella polyvalent antiserum.
b. probably an Arizona and a malonate broth should be set up.
c. probably Citrobacter freundii and the ONPG test should be performed .
d. a Proteus vulgaris and therefore it should not be worked up any further.

36. The anaerobic gram negative rod that is a major pathogen of man is:

a. Bacteroides sp.
b. Fusobacterium sp.
c. Lactobacillus sp.
d. Propionibacterium sp.

37. An anaerobic gram positive rod is isolated from a peritoneal abscess. The gram stain reveals occasional subterminal spores. The organism belongs to the Genus:

a. Bacillus.
b. Bacteroides.
c. Clostridium.
d. Eubacterium.

38. To ensure the growth of Bacteroides melaninogenicus on anaerobic media, appropriate amounts of _________ and ___________ must be incorporated into the media.

    a. hemin and Vitamin A
    b. hemin and Vitamin K
    c. horse blood and kanamycin
    d. Vitamin K and menadione

39. The following are methods of obtaining anaerobic conditions EXCEPT:

    a. GasPak jar.
    b. Glove box.
    c. Candle jar.
    d. Prereduced media.

40. Double zone hemolysis is an identifying characteristic of:

    a. Clostridium botulinum.
    b. Clostridium ramosum.
    c. Clostridium perfringens.
    d. Clostridium tetani.

41. The presence of sulfur granules composed of aggregates of filamentous organisms seen from an exudate is indicative of:

    a. Actinomyces.
    b. Bacteroides.
    c. Clostridium.
    d. Propionibacterium.

42. Which of the following specimens should be cultured for anaerobes?

    a. pleural fluids.
    b. bronchial washings.
    c. clean catch urines.
    d. urethral swabs.

43. A primary isolation medium for the isolation of anaerobes would be:

    a. MacConkey agar.
    b. Tergitol agar.
    c. Xylose Lysine Desoxycholate agar.
    d. Schaedler's Blood agar with Vitamin K.

44. A swab is obtained from an oral infection and cultured aerobically and anaerobically. The organism only grows anaerobically as small, translucent colonies without any odor. The gram stain reveals gram positive cocci in pairs, short chains and irregular clumps. The most probable genus is:

    a. Actinomyces.
    b. Clostridium.
    c. Peptococcus.
    d. Veillonella.

45. The presence of lecithinase in Clostridium perfringens can be determined on:

    a. Columbia CNA agar.
    b. Cooked Meat medium.
    c. Egg Yolk agar.
    d. Kanamycin Vancomycin medium.

46. An anaerobic gram negative rod whose growth is stimulated by the presence of bile in the medium and grows in the presence of 2 units of penicillin is:

    a. Bacteroides fragilis.
    b. Bacteroides melaninogenicus.
    c. Fusobacterium nucleatum.
    d. Fusobacterium fusiforme.

47. A gram negative non-motile bacillus is isolated anaerobically from a blood culture that was hemolyzed and had a foul odor. No growth was observed in the aerobic bottle. These findings are compatible with:

    a. Bacteroides sp.
    b. Brucella sp.
    c. Clostridium sp.
    d. Hemophilus sp

48. A diabetic patient is admitted to the hospital with a gaseous foot wound. What anaerobic organism is the most likely cause of this abscess?

    a. Bacillus cereus.
    b. Bacteroides fragilis.
    c. Clostridium perfringens.
    d. Fusobacterium nucleatum.

49. Anaerobic transport containers are used for the collection and transport of clinical material so that:

    a. organisms remain viable, but in a static state.
    b. growth of normal flora is inhibited.
    c. optimal nutrient conditions are maintained to allow the organism in the specimen to grow.
    d. aerobes can be differentiated from anaerobes.

50. An anaerobic culture is received in the laboratory. The gram stain shows large gram negative rods. On culture, Clostridium perfringens is isolated. What might explain this discrepancy?

a. The organism seen on gram stain was not isolated.
b. The technologist overdecolorized the gram stain.
c. The organism is an obligate aerobe.
d. The organism is an obvious contaminant.

51. Staphylococcus epidermidis is:

a. coagulase negative.
b. catalase negative.
c. mannitol positive.
d. salt intolerant.

52. Streptococcus pneumoniae produce a green ring around the colonies on blood agar. The greening of the medium is due to:

a. an alpha lysin.
b. a gamma lysin.
c. a lipochrome.
d. optochin.

53. Thayer-Martin medium is used as primary isolation medium for:

a. Hemophilus influenzae.
b. Neisseria gonorrhoeae.
c. Streptococcus pyogenes.
d. Corynebacterium diphtheriae.

54. Most Streptococcus pneumoniae are:

a. bile insoluble.
b. alpha hemolytic.
c. optochin resistant.
d. non-hemolytic

55. Hemolysis which is described as a clear, colorless zone surrounding the colony, indicating complete lysis of the red blood cells is:

a. alpha
b. beta.
c. gamma.
d. alpha-prime.

56. Enterococci are:

    a. alpha or beta hemolytic.
    b. gamma hemolytic.
    c. alpha or gamma hemolytic.
    d. alpha, beta or gamma hemolytic.

57. In the performance of the coagulase test, oxalated plasma is preferable to citrated plasma because:

    a. it is readily obtained from the chemistry laboratory.
    b. some bacteria utilize citrate.
    c. oxalate is more readily soluble than citrate.
    d. some bacteria utilize oxalate.

58. All species of the genus Neisseria have the capacity to oxidize:

    a. glucose.
    b. poly-B-hydroxybutyric acid.
    c. para-dimethyl aminobenzaldehyde.
    d. tetramethyl-p-phenylenediamine HCl

59. The gas that is produced by catalase positive organisms is:

    a. carbon dioxide.
    b. hydrogen.
    c. nitrogen.
    d. oxygen.

60. Evolution of gas after hydrogen peroxide has been poured over the bacteria indicates a positive:

    a. indole test
    b. citrate test.
    c. esculin test.
    d. catalase test.

61. Which test would be most useful in identifying Group B beta hemolytic streptococci?

    a. bacitracin.
    b. bile solubility.
    c. bile esculin hydrolysis.
    d. C.A.M.P. test.

62. Which tests would be most useful to differentiate between alpha hemolytic streptococci and Streptococcus pneumoniae?

    a. bacitracin susceptibility and esculin hydrolysis.
    b. optochin susceptibility and esculin hydrolysis.
    c. bile solubility and optochin susceptibility.
    d. catalase and bile solubility.

63. A catalase test would be useful in distinguishing:

    a. alpha from beta hemolytic streptococci.
    b. staphylococci from micrococci.
    c. micrococci from streptococci.
    d. streptococci from pneumococci.

64. Which test would be most useful in identifying Group D beta hemolytic streptococci?

    a. bacitracin.
    b. bile solubility.
    c. bile esculin hydrolysis.
    d. sodium hippurate hydrolysis.

65. Enterococci are:

    a. bile esculin positive and 6.5% NaCl positive.
    b. bile esculin negative and 6.5% NaCl negative.
    c. bile esculin positive and 6.5% NaCl negative.
    d. bile esculin negative and 6.5% NaCl positive.

66. Which is the best single test for identifying Staphylococcus aureus?

    a. mannitol fermentation.
    b. hemolysis.
    c. esculin hydrolysis.
    d. coagulase.

67. In females the best site to culture for the isolation of Neisseria gonorrhoeae is the:

    a. cervix.
    b. rectum.
    c. urethra.
    d. vagina.

68. Which blood agar medium should be used to best detect beta hemolysis of streptococci?

    a. sheep.
    b. human.
    c. rabbit.
    d. chicken.

69. Which organism would not be included in the viridans group of streptococci?

    a. Streptococcus mutans.
    b. Streptococcus pyogenes.
    c. Streptococcus mitis.
    d. Streptococcus sanguis.

70. Thayer-Martin medium consists of chocolate agar with the addition of:

    a. NAD.
    b. VCN.
    c. penicillinase.
    d. Factors X and V.

71. Gram positive cocci that occur singly, in pairs or in long chains belong to the Genus:

    a. Staphylococcus.
    b. Streptococcus.
    c. Micrococcus.
    d. Neisseria.

72. Hemophilus influenzae is best isolated on:

    a. Bordet-Gengou agar.
    b. Chocolate agar.
    c. Sheep blood agar with Vitamin K.
    d. Thayer-Martin medium.

73. Which organism is optochin disc sensitive, bile soluble and can be identified with a Quellung reaction?

    a. Streptococcus faecalis.
    b. Streptococcus pyogenes.
    c. Streptococcus pneumoniae.
    d. Streptococcus mutans.

74. Colonies of salt-tolerant Staphylococcus aureus appear on this medium surrounded by a readily visible yellow halo.

    a. bile esculin agar.
    b. C.A.M.P.
    c. 6.5% Sodium Chloride medium.
    d. Mannitol salt agar.

75. Which pair of organisms are most easily differentiated on the basis of gram stain morphology?

a. Staphylococcus sp. from Micrococcus sp.
b. Listeria sp. from Corynebacterium sp.
c. alpha hemolytic streptococci from beta hemolytic streptococci.
d. Staphylococcus sp. from Corynebacterium sp.

76. A gram stain performed on a cervical smear showed gram negative intracellular diplococci. The organism will most likely:

a. grow on sheep blood agar in CO_2 at 37°C.
b. oxidize glucose and maltose.
c. be oxidase negative.
d. grow on chocolate agar containing VCN.

77. Streptococcus Group D will not grow on MacConkey agar because this medium contains:

a. lactose.
b. neutral red.
c. bile salts.
d. colistin.

78. Which pair of organisms are most easily differentiated by colonial morphology when grown on sheep blood agar incubated in reduced oxygen tension?

a. Streptococcus pyogenes and Staphylococcus aureus.
b. Neisseria meningitidis and Neisseria gonorrhoeae.
c. Corynebacterium diphtheriae and Erysipelothrix sp.
d. Listeria monocytogenes and Streptococcus Group B.

79. Hemolytic streptococci are divided serologically into groups based on their group-specific cellular antigen known as the:

a. M protein.
b. T protein.
c. Mucoprotein.
d. C carbohydrate.

80. A gram negative bacilli grows on chocolate agar and rabbit blood agar, but does not grow on sheep blood agar. The organism does display "satellitism" with Staphylococcus aureus on sheep blood agar but does not satellite on nutrient agar. Which statement is true concerning this organism? It requires:

a. X factor but not V factor.
b. V factor but not X factor.
c. both X and V factors.
d. neither X nor V factors.

81. A zone of inhibition of growth around a bacitracin disc indicates that the organism is probably beta hemolytic Streptococcus Group:

a. A
b. B
c. D
d. G

82. Blood agar plates, when used for the detection of beta hemolytic streptococci, are incubated in an atmosphere with reduced oxygen tension because:

a. beta streptococci grow best at reduced oxygen tension.
b. beta streptococci produce a streptolysin that is oxygen labile.
c. the hemolysin penetrates the agar better in a CO_2 environment.
d. it inhibits other organisms that might overgrow the beta streptococci.

83. Certain stains of streptococci, when grown on sheep blood agar in close proximity to a beta toxin-producing strain of Staphylococcus aureus, produce a peculiar lytic phenomenon referred to as "arrow head hemolysis". Which group of streptococci is associated with this reaction?

a. A
b. B
c. D
d. G

84. Which of the following statements is NOT true concerning Neisseria meningitidis?

a. It grows well on plain chocolate agar.
b. It grows well on Transgrow medium.
c. It is cytochrome oxidase positive.
d. It utilizes glucose and sucrose.

85. All of the following statements are true concerning Branhamella catarrhalis EXCEPT that it:

a. is normal flora in the respiratory tract.
b. is oxidase positive.
c. utilizes dextrose and maltose.
d. was formerly called Neisseria catarrhalis.

86. A gram positive lancet-shaped organism found on a gram stained smear of an ear culture is suggestive of:

a. Acinetobacter sp.
b. Listeria sp.
c. Micrococcus sp.
d. Streptococcus sp.

87. Hemophilus hemolyticus and beta hemolytic streptococcus can have similar morphology on rabbit blood agar leading to confusion when screening throat cultures for streptococci. To eliminate this problem:

a. perform a gram stain on all colonies.
b. use sheep blood agar which inhibits hemolysis of H. hemolyticus.
c. ignore the beta hemolytic colonies on the blood agar.
d. add crystal violet to the media which inhibits H. hemolyticus.

88. A pure culture of gram positive cocci have been isolated from a lesion of the mouth. There are many large, yellowish, opaque, smooth colonies on the sheep blood agar plate. What would be the next step in the identification of this organism?

a. Perform a gram stain.
b. Perform an oxidase test.
c. Perform a coagulase test.
d. Subculture to a CNA agar plate.

89. A gram positive coccus has been isolated that morphologically appear to be Staphylococcus aureus. The result of a slide test for coagulase using fresh rabbit plasma is negative. Your next step would be to:

a. repeat the slide coagulase test.
b. report as Staphylococcus epidermidis.
c. perform a tube coagulase test.
d. set up a 6.5% NaCl broth.

90. The direct gram stain of a sputum specimen reveals many gram positive cocci in chains and pairs. Many small alpha hemolytic colonies are seen on the sheep blood agar plate. It is not clear, however, whether the organisms are pneumococci or alpha hemolytic streptococci. Which test would make this differentiation?

a. bacitracin.
b. bile esculin.
c. catalase.
d. optochin.

91. The best procedure to differntiate Listeria monocytogenes from Corynebacterium species is :

a. the catalase test.
b. a gram stain.
c. motility testing.
d. fermentation of glucose.

92. Corynebacterium may be cultured for primary isolation on all of the following media EXCEPT:

   a. sheep blood agar.
   b. cystine tellutite agar.
   c. Loeffler's medium.
   d. Bordet-Gengou agar.

93. An organism formerly classified as a Vibrio that is frequently isolated from cases of diarrhea and that requires selective media in reduced oxygen tension is:

   a. Treponema pallidum.
   b. Leptospira interrogans.
   c. Chlamydia trachomatis.
   d. Campylobacter fetus.

94. Members of the genus Brucella are:

   a. best cultured in modified Castaneda blood culture bottles.
   b. rapid growers.
   c. gram positive cocci in packets.
   d. the causative agent of whooping cough.

95. Most spirochetes are best observed:

   a. in stained blood films.
   b. using highly enriched media.
   c. using dark field microscopy.
   d. with a Wood's lamp.

96. Media used for the isolation of Mycobacteria include:

   a. Sabouraud Dextrose agar.
   b. tissue culture media.
   c. GN broth.
   d. Middlebrook 7H10.

97. The acid-fast property of Mycobacteria is due to the:

   a. presence of caseous particles in the cell wall.
   b. presence of lipoid substance in the cell wall.
   c. use of methylene blue as a counterstain.
   d. use of Lowenstein Jensen as a primary plating medium.

98. Specimens of choice for the isolation of Mycobacterium tuberculosis include all of the following EXCEPT:

   a. expectorated sputum.
   b. fresh, first-morning urine specimen.
   c. salivary secretions.
   d. cerebrospinal fluid.

99. Which of the following would be a suitable counterstain for use with the Ziehl-Neelson acid-fast stain?

    a. carbol fuschin.
    b. malachite green.
    c. phenol red/eosin.
    d. safranin.

100. The purpose of using N-acetly-l-cysteine in concentration procedure for Mycobacteria is to:

    a. neutralize antimicrobial interference.
    b. enhance the growth of the mycobacteria.
    c. digest the mucus of sputum and other specimens.
    d. neutralize the sediment before inoculating the media.

101. Specimens for viral culture that are to be transported to a reference or public health laboratory should be:

    a. chilled to 4°C and shipped on ice.
    b. quick frozen and shipped on dry ice.
    c. kept at room temperature.
    d. shipped in Stuart's transport medium.

102. Proper blood culture collection requires cleansing and disinfecting of the skin surface area prior to venipuncture with:

    a. alcohol and staphene.
    b. alcohol and betadine.
    c. acetone and staphene.
    d. acetone and betadine.

103. The percentage of blood generally used in preparing blood agar plates is:

    a. 2%
    b. 5%
    c. 10%
    d. 20%

104. In preparing media, it is important to remember that agar solidifies at:

    a. 32°C.
    b. 42°C.
    c. 56°C.
    d. 80°C.

105. The anticoagulant often incorportated into blood culture broth is:

a. sodium oxalate.
b. sodium citrate.
c. sodium heparin.
d. sodium polyanethol sulfonate.

106. The maximum number of days that a routine blood culture should be incubated before reporting as "No growth" is:

a. 3
b. 7
c. 14
d. 21

107. The percentage of carbon dioxide most desirable for the incubation of chocolate and blood agar plates is:

a. 1-2%
b. 3-5%
c. 5-10%
d. 10-15%

108. The indicator generally used to monitor anaerobic conditions during anaerobic incubation is:

a. bromthymol blue.
b. crystal violet.
c. methylene blue.
d. palladium.

109. The mordant employed to bind the primary stain to the cell wall of bacteria in the gram stain procedure is:

a. acetone-alcohol.
b. distilled water.
c. iodine.
d. crystal violet.

110. Stained bacteria are best observed microscopically with the:

a. high dry objective.
b. oil immersion objective.
c. 10X lens.
d. 40X lens.

111. Sputum specimens collected for the culture of bacteria, mycobacteria or fungi are best obtained:

a. as a 24-48 hour pooled specimen.
b. one-half hour after a meal.
c. in the evening before sleep.
d. in the morning before breakfast.

112. An example of a selective and differential medium is:

  a. CNA agar.
  b. PEA agar.
  c. XLD agar.
  d. Thayer-Martin medium.

113. A highly selective medium that does not require autoclaving during its preparation is:

  a. Hektoen Enteric agar.
  b. MacConkey agar.
  c. Simmon Citrate agar.
  d. Transgrow.

114. Isolation techniques include all of the following EXCEPT:

  a. broth culture.
  b. calibrated loop inoculation.
  c. pour plate method.
  d. streak plate method.

115. Bacteria found in a clean-voided urine is considered to be significant if present in the following amount or greater:

  a. 1,000 col/ml of a pure culture.
  b. 10,000 col/ml of two organisms.
  c. 100,000 col/ml of two organisms.
  d. 1,000,000 col/ml of three organisms.

116. Organisms that possess thick-waxy capsules that are resistant to staining but do not decolorize after treatment with acid-alcohol are called:

  a. acid-fast.
  b. acid-resistant.
  c. gram negative.
  d. gram positive.

117. The procedure manual calls for the subculturing of the Selenite Broth from stool cultures to EMB and Hektoen Enteric media, however, you have no Hektoen media available. You can substitute:

  a. CNA agar.
  b. XLD agar.
  c. PEA agar.
  d. MacConkey agar.

118. The electric power which maintains the incubators in a laboratory shuts off and the length of time expected for the power to return is not known. What is the best procedure to take?

a. Hold all cultures at room temperature.
b. Leave the incubator closed until the power is returned.
c. Move all cultures to a warm area of the laboratory.
d. Transfer all cultures to another obliging laboratory.

119. Sulfonamides interfer with:

a. the bacterium's cytochrome system.
b. synthesis of nucleic acid.
c. cell membrane development.
d. synthesis of the metabolite p-aminobenzoic acid.

120. The antimicrobial agent that inhibits cell wall synthesis is:

a. chloramphenicol.
b. penicillin.
c. polymyxin.
d. gentamycin.

121. The agar most frequently used for susceptibility testing is:

a. brain heart infusion.
b. tryptic soy.
c. Mueller-Hinton.
d. Moeller's base.

122. The recommended depth of agar in the Kirby-Bauer disc diffusion method of susceptibility testing is:

a. 1-3 mm.
b. 4-6 mm.
c. 7-8 mm.
d. 9-10 mm.

123. The term susceptible implies that:

a. an infection caused by the strain tested may be expected to respond favorably to the indicated antimicrobial for that type of infection and pathogen.
b. the strains are not inhibited completely by therapeutic concentrations of the antibiotic.
c. strains may respond to unusually high concentrations of the agent.
d. further testing of alternate antimicrobial agents is warranted.

124. For long term storage, susceptibility discs are best maintained in:

   a. a dessicator at 22°C.
   b. a dessicator at 35°C.
   c. a refrigerator.
   d. a frozen state.

125. The organisms generally used in the Quality Control of susceptibility testing include all of the following EXCEPT:

   a. Escherichia coli.
   b. Klebsiella pneumoniae.
   c. Pseudomonas aeruginosa.
   d. Staphylococcus aureus.

126. In standardizing the inoculum used in the Kirby-Bauer procedure, the inoculum is compared to a standard of:

   a. barium sulfate.
   b. ferric chloride.
   c. potassium hydroxide.
   d. zinc sulfate.

127. Susceptibility studies on streptococci and enterococci are generally performed on:

   a. chocolatized Mueller-Hinton agar.
   b. Sheep blood agar with a trypticase soy base.
   c. Sheep blood agar with a Mueller-Hinton base.
   d. Brain heart infusion agar with added horse serum.

128. In the Kirby Bauer procedure, the size of the zone of inhibition indicating sensitivity is determined by correlating zone size with the:

   a. antibiotic content of the disc.
   b. clinical response of the patient.
   c. minimum inhibitory concentration.
   d. minimum bactericidal concentration.

129. Which organism should NOT be tested for susceptibility by the Kirby Bauer disc method?

   a. Proteus mirabilis.
   b. Neisseria gonorrhoeae.
   c. Staphylococcus epidermidis.
   d. Acinetobacter calcoaceticus.

130. Direct susceptibility testing may be performed:

   a. routinely on most specimens.
   b. when several organisms are expected to grow on culture.
   c. when only non-pathogens are expected to grow on culture.
   d. on blood cultures after observing the gram stained smear.

131. A quantitative estimation of antibiotic sensitivity may be obtained most accurately by:

a. determining the size of the zone of inhibition.
b. performing serial dilutions of the antibiotic.
c. measuring the amount of growth in a single tube of medium containing the antibiotic.
d. using sensitivity discs containing three concentrations of the antibiotic.

132. The most commonly used method for susceptibility testing of microorganisms is:

a. agar overlay method.
b. disc diffusion method.
c. replicate plate method.
d. serial dilution method.

133. A Kirby Bauer sensitivity test was set up on a pure culture of Escherichia coli. The zone of inhibition around a 100ug disc of carbenicillin measured 15 mm. Using the chart below, how would you interpret this reading?

Zone Size Interpretations

Antimicrobic Agent	Disc Potency	Inhibition zone diameter in mm		
		Resistant	Intermediate	Susceptible
Amikacin(-)	10 ug	11 or less	12-13	14 or more
Ampicillin (-)(+)	10 ug			
Staphylococci		20 or less	21-28	29 or more
Enterics and enterococci		11 or less	12-13	14 or more
Hemophilus		19 or less	-	20 or more
Carbenicillin (-)	100ug			
Pseudomonas sp.		13 or less	14-16	17 or more
Proteus and E. coli		17 or less	18-22	23 or more
Cephalosporin (-)(+)	30 ug	14 or less	15-17	18 or more
Chloramphenicol(-)(+)	30 ug	12 or less	3-17	18 or more
Clindamycin (+)	2 ug	14 or less	5-16	17 or more
Erythromycin(+)	15 ug	13 or less	14-17	18 or more
Gentamycin(-)(+)	10 ug	12 or less	13-14	15 or more
Kanamycin (-)(+)	30 ug	13 or less	14-17	18 or more
Methicillin(+)	5 ug	9 or less*	10-13	14 or more
Naladixic Acid (u)	30 ug	13 or less	14-18	19 or more
Nitrofurantoin (u)	300 ug	14 or less	15-16	17 or more
Penicillin G (+)(-)	10 U			
Staphylocucci		20 or less	21-28	29 or more
other organisms		11 or less	12-21	22 or more
Polymyxin B (-)	300 U	8 or less	9-11	12 or more
Sulfonamides (u)	250-300 ug	12 or less	13-16	17 or more
Tetracycline(+)(-)	30 ug	14 or less	15-18	19 or more
Tobramycin(-)(+)	10 ug	11 or less	12-13	14 or more
Trimethoprim-sulfamthoxazole (-)(+)	25 ug	10 or less	11-15	16 or more

a. resistant.
b. intermediate.
c. susceptible.
d. additional data required before interpreting.

134. A laboratory needs to place a number of discs on each susceptibility plate. In order to prevent overlapping of the zones of inhibition, the discs should be placed no closer than:

a. 12 mm.
b. 14 mm.
c. 20 mm.
d. 24 mm.

135. What information, in addition to susceptibility, can sometimes be obtained from performing an antibiotic susceptibility test?

a. that the organism is from an enviromental or a human source.
b. that two antibiotics are acting antagonistically.
c. proof of the organism's virulence capability.
d. possible misidentification of the isolate.

136. To sterilize using steam under pressure, at 15 PSI, the required temperature is:

a. 102°C.
b. 110°C.
c. 121°C.
d. 126°C.

137. The most common method of sterilization is:

a. freezing.
b. heat.
c. radiation.
d. filtration.

138. Media containing lactose should be sterilized by:

a. boiling.
b. dry heat.
c. ethylene oxide.
d. filtration.

139. A carrier is a person who:

a. is in the incubation stage of a disease.
b. has never had overt disease but harbors the organism.
c. may have had overt disease and continues to harbor the organism.
d. is asymtomatic for a disease because of protective antibodies present in his blood.

140. A epidemiological tool used by state health department laboratories for investigating hospital outbreaks of infections due to Staphylococcus aureus is:

a. coagulase testing.
b. serotyping.
c. biotyping.
d. bacteriophage typing.

141. An opportunistic pathogen:

a. causes disease in any host.
b. is capable of inducing disease in a healthy host.
c. is not capable of inducing disease in a healthy host.
d. lowers the resistance of a healthy host so that another organism can cause disease.

142. Thermometers used in laboratory freezers should:

a. be suspended in glyerine and water.
b. be suspended in phosphate buffer.
c. be suspended in distilled water.
d. hang freely.

143. Good quality control cannot be maintained without knowledgable employees. This requires continuing education, proficiency testing, blind unknowns and:

a. a good lab director.
b. an adequate procedure manual.
c. extensive supervision.
d. extensive stock culture collections.

144. Cylinders of gas in the laboratory should be:

a. chained together tightly to prevent accidents.
b. individually chained at all times.
c. can be left unchained when empty.
d. chained loosely to allow some maneuverability.

145. Sugars, serum and tissue extracts should be sterilized by:

a. filtration.
b. heat under pressure.
c. live steam.
d. special chemical agents.

146. The use of plain soap and water for handwashing by hospital personnel is:

a. sufficient for all occasions.
b. sufficient for some occasions, but antiseptics are more highly recommended at other times.
c. improper since antiseptics should always be used.
d. not recommended since the water may be contaminated.

147. Susceptibility quality control data can be evaluated by plotting the zone sizes and are subject to a normal bell-shaped curve distribution. Therefore, which of the following would NOT be considered an out-of-control situation?

a. two plots in 30 days falling outside the mean ± 2 SD.
b. three plots in 20 days falling outside the mean ± 2 SD.
c. six successive plots falling on the mean value.
d. six successive plots falling above or below the mean value.

148. Which item(s) is(are) NOT a necessary precaution to take when culturing clinical specimens suspected of containing mycobacteria?

a. an isolation hood or cabinet.
b. gloves and gown.
c. filter mask for the face.
d. self-contained breathing apparatus.

149. The best method to quality control a wound specimen that is received would be:

a. by proficiency testing the personnel periodically.
b. to gram stain the specimen and correlate the results with the growth obtained.
c. to perform daily quality control on all reagents and equipment utilized.
d. to plate stock organisms to a similar set of media.

150. A set of stock cultures is maintained to check all media and reagents. In order to test for positive and negative reactions, which combination is appropriate?

a. coagulase--Staphylococcus epidermidis and Streptococcus pneumoniae.
b. gram stain--Escherichia coli and Staphylococcus aureus.
c. hydrogen sulfide--Salmonella and Proteus mirabilis.
d. oxidase--Neisseria gonorrhoeae and Pseudomonas aeruginosa.

CONTINUE ON NEXT PAGE

151. Dermatophytes are fungi which cause:

   a. cutaneous mycoses.
   b. subcutaneous mycoses.
   c. systemic mycoses.
   d. opportunistic mycoses.

152. Hyphae which break into rectangular conidia are called:

   a. arthrospores.
   b. ascospores.
   c. blastospores.
   d. sporangiospores.

153. 10% KOH mounts are used to demonstrate:

   a. fungal elements in skin.
   b. blastospores in CSF.
   c. chlamydospores in agar.
   d. conidia in soil.

154. The pH of Saboraud's dextrose agar is:

   a. 5.6
   b. 7.0
   c. 7.5
   d. 8.5

155. The drug of choice for the treatment of many fungal infections is:

   a. ampicillin.
   b. amphotericin B.
   c. chloramphenicol.
   d. cycloheximide.

156. Aerial hyphae are usually:

   a. glabrous.
   b. reproductive.
   c. septated.
   d. sterile.

157. Hair infected with fungi can often be detected by:

   a. fluorescent light.
   b. special shampoo.
   c. Wood's lamp.
   d. X-ray.

158. Coccidioidomycosis is a fungus infection acquired by inhaling:

a. arthrospores.
b. blastospores.
c. chlamydospores.
d. microconidia.

159. Cryptococcus is a yeast which produces:

a. indole.
b. macroconidia.
c. septate hyphae.
d. urease.

160. One organism which causes Chromomycosis is:

a. Actinomyces israelii.
b. Cladosporium carrionii.
c. Microsporum canis.
d. Trichophyton tonsurans.

161. Aspergillus sp., a common laboratory contaminant, can:

a. become an opportunistic pathogen.
b. cause tinea capitis.
c. never be pathogenic.
d. grow as a yeast phase.

162. A yeast may be described as:

a. wooly, tan, dry.
b. white, smooth, pasty.
c. powdery, grey, heaped.
d. floccose, white.

163. Thick walled terminal spores produced in times of poor environmental conditions on corn meal agar are called:

a. blastospores.
b. chlamydospores.
c. thallospores.
d. germ tubes.

164. The purpose of lactophenol cotton blue stain is to:

a. dissolve hyphae and stain spores.
b. dissolve tissue and fat.
c. kill the fungus and outline structures.
d. preserve living fungi.

165. Cornmeal agar is used for the production of:

   a. ascospores.
   b. chlamydospores.
   c. pigment.
   d. vegetative hyphae.

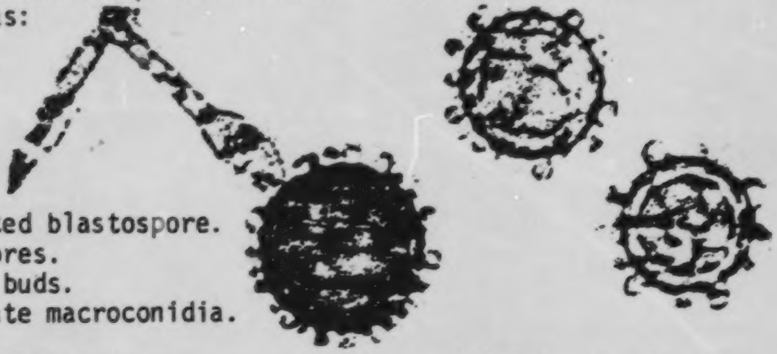
166. Favic chandelier-type branching is seen in the growth of:

   a. Trichophyton rubrum.
   b. Trichophyton schoenleinii
   c. Microsporum canis.
   d. Epidermophyton floccosum.

167. A bluish-green powdery fungus grown from a patient's specimen has been identified as the causative agent of a mycosis. Microscopic examination can differentiate:

   a. Rhizopus from Mucor.
   b. Penicillium from Aspergillus.
   c. Microsporum from Trichophyton.
   d. Blastomyces from Histoplasma.

168. Microscopic examination of the mold phase of a dimorphic organism revealed the picture below. This structure is referred to as:



   a. echinulated blastospore.
   b. arthrospores.
   c. multiple buds.
   d. tuberculate macroconidia.

169. A drop of spinal fluid from a meningitis patient is mixed with a drop of India ink on a slide. A large encapsulated single, budding blastospore is seen. The organism is most likely:

   a. Candida albicans.
   b. Cryptococcus neoformans.
   c. Geotrichum candidum.
   d. Histoplasma capsulatum.

170. A fungus disease which is an occupational hazard of florists, nurserymen, and gardners is acquired through accidental thorns or splinters in the hands and skin surface. This disease is:

a. Actinomycosis.
b. Cryptomycosis.
c. Histoplasmosis.
d. Sporotrichosis.

171. A vector is an:

a. arthropod or other living carrier which transports disease.
b. inanimate object which transmits disease.
c. insect which has a poisonous bite.
d. intermediate host.

172. The sexual stage of the Plasmodia is found in:

a. fleas.
b. man.
c. mosquitoes.
d. ticks.

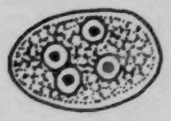
173. Sexual intercourse is a mode of transmission for:

a. Toxoplasma gondii.
b. Trichomonas vaginalis.
c. Trichomonas hominis.
d. Trypanosoma gambiensis.

174. The intestinal amoeba that is considered a human pathogen is:

a. Entamoeba gingivalis.
b. Entamoeba coli.
c. Entamoeba histolytica.
d. Endolimax nana.

175. The identification of the intestinal amoeba pictured below is:



a. Iodamoeba butschlii cyst.
b. Iodamoeba butschlii trophozoite.
c. Endolimax nana cyst.
d. Endolimax nana trophozoite.

176. The karyosome of Entamoeba histolytica can be described as:

a. basket-like.
b. relatively small and delicate.
c. large and fragmented.
d. invisible on Trichrome stain.

177. The flagellate that demonstrates two large sucking discs in the trophozoite stage is:

a. Chilomastix mesnili.
b. Giardia lamblia.
c. Balantidium coli.
d. Trypanosoma cruzi.

178. All of the following protozoa are flagellates EXCEPT:

a. Chilomastix mesnili.
b. Leishmania tropica.
c. Plasmodium vivax.
d. Trypanosoma gambiense.

179. The pathogenic protozoa which infects the duodenum and may be recovered by duodenal washings is:

a. Chilomastix mesnili.
b. Giardia lamblia.
c. Strongyloides stercoralis.
d. Wuchereria bancrofti.

180. The only Plasmodium species that can be identified by its gametocytes alone is:

a. cruzi.
b. falciparum.
c. malariae.
d. vivax.

181. The parasite transmitted through ingestion of cysts that can be found in cat feces is:

a. Entamoeba coli.
b. Echinococcus granulosum.
c. Pneumocystis carinii.
d. Toxoplasma gondii.

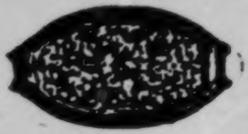
182. The parasite that can be diagnosed by use of the Scotch Tape test is:

a. Ascaris lumbricoides.
b. Enterobius vermicularis.
c. Necator americanus.
d. Trichinella spiralis.

183. The rhabditiform larvae and ova are indistinguishable between:

    a. Ascaris and Strongyloides.
    b. Hookworm and Enterobius.
    c. Necator and Ascaris.
    d. Strongyloides and Hookworm.

184. The roundworm that has a bile-stained ova resembling a Chinese lantern as pictured below is:



    a. Ascaris lumbricoides.
    b. Enterobius vermicularis.
    c. Paragonimus westermani.
    d. Trichuris trichiura.

185. Diphyllobothrium latum is also known as the:

    a. mouse tapeworm.
    b. fish tapeworm.
    c. hydatid worm.
    d. dog hookworm.

186. The fluke which characteristically infects the host's lungs and whose ova may be found in sputum is:

    a. Clonorchis sinensis.
    b. Dipylidium caninum,
    c. Heterophytes heterophytes.
    d. Paragonimus westermani.

187. A parasite seen most frequently in centrifuged urine from infected patients in the United States is:

    a. Ascaris lumbricoides.
    b. Entamoeba histolytica.
    c. Schistosoma hematobium.
    d. Trichomonas vaginalis.

188. A person who may ingest food contaminated with feces may be subject to infection with all of the following EXCEPT:

    a. Entamoeba histolytica.
    b. Balantidium coli.
    c. Necator americanus.
    d. Hymenolepsis nana.

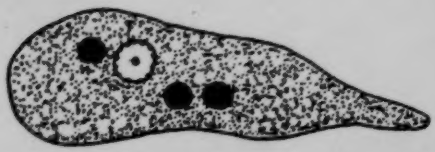
189. Ingestion of inadequately cooked pork increases the risk of infection with:

a. Diphyllobothrium latum.
b. Echinococcus granulosus.
c. Taenia saginata.
d. Trichinella spiralis.

190. A large, spherical cyst with 5 nuclei that has coarsely granular, unevenly arranged peripheral chromatin is most likely:

a. Entamoeba coli.
b. Entamoeba hartmanni.
c. Entamoeba histolytica.
d. Endolimax nana.

191. A trichrome stain reveals the protozoan pictured below. It exhibits 1 nucleus that has a small, compact karyosome centrally located with fine granules surrounding this nucleus. The cytoplasm is finely granular and contains ingested red blood cells. This organism can be identified as:



a. Entamoeba coli.
b. Entamoeba histolytica.
c. Endolimax nana.
d. Dientamoeba fragilis.

192. The peripheral smear of a person with malaria demonstrates a moderate amount of ring forms in large to oval red blood cells. Schuffner's dots are present in many of the red blood cells and occasional mature schizonts with 16-20 merozoites are seen. The plasmodium can be identified as:

a. falciparum.
b. malariae.
c. ovale.
d. vivax.

193. The ova of Ascaris lumbricoides can be described as:

a. large, oval and operculated.
b. thick walled with a prominent lateral spike.
c. large, thick mammilated shelled.
d. thin walled with one side flattened.

194. The purpose of performing a formalin-ether concentration procedure includes all of the following EXCEPT:

a. to allow the detection of a small number of organisms that may be missed using only the direct mount.
b. to detect motile trophozoites that might otherwise be "hidden" in fecal debris.
c. to allow the recovery of all protozoa, eggs and larvae by extracting debris in the ether layer.
d. to kill the organism and to preserve the specimen after concentration.

195. During treatment for abdominal obstruction due to a tapeworm, the patient passes the scolex and a segment of proglottids. The scolex has a circle of hooks and the proglottids have 7 to 12 main lateral branches. The tapeworm can be identified as:

a. Taenia solium.
b. Diphyllobothrium latum.
c. Fasciola hepatica.
d. Hymenolepsis diminuta.

196. A stool left at room temperature for several hours contains Hookworm ova. Upon examination, the parasite may be INCORRECTLY identified as:

a. Ancylostoma duodenale.
b. Enterobius vermicularis.
c. Necator americanus.
d. Strongyloides stercoralis.

197. The flotation technique for concentration of ova and parasites:

a. cannot be used on formed stools.
b. recovers operculated ova better than the sedimentation method.
c. employs a high specific gravity of zinc sulfate.
d. distorts protozoan cysts more than the sedimentation method.

198. An outpatient calls the laboratory to find out how he is to collect a stool specimen for ova and parasites. You would most likely suggest:

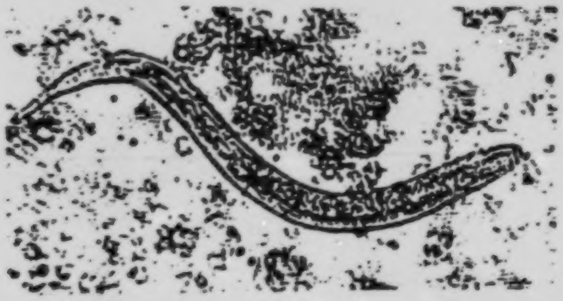
a. a minimum of three fecal specimens collected on alternate days that are brought to the laboratory each day of collection.
b. three specimens collected in a preservative of D'Antoni's iodine.
c. six consecutive stool samples that are kept warm until examination.
d. three stool specimens collected by mineral oil enema.

199. On a direct wet preparation of a diarrhetic stool, an organism is identified as an amoeba. The next day a sample of the specimen is prepared and stained with a permanent stain such as trichrome, however, no amoebic organisms are seen. The most likely explanation is that the:

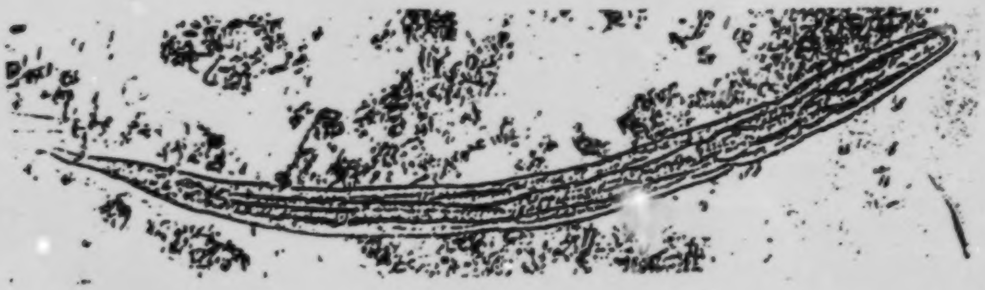
a. specimen was not fixed soon enough after receipt and the apparent trophozoites seen did not survive.
b. specimen contained barium sulfate which interfers with the staining procedure.
c. amoebic structures cannot be stained well with the trichrome stain and were probably over missed.
d. specimen was mistakenly identified on the direct wet preparation.

200. The structures shown below are two different fields under different magnification from the same specimen. Identify these structures.

I (low power)



II
(high power)



a. I is an artifact, II is larva of Strongyloides.
b. I is a larva of Strongyloides, II is an artifact.
c. I and II are both larvae of Strongyloides.
d. I and II are both microfilariae of Wuchereria bancrofti.

THE END

MT - A

1. A member of Enterobacteriaceae that does not possess a flagella is:

   a. Klebsiella.
   b. Proteus.
   c. Serratia.
   d. Salmonella.

2. All of the following are enrichment broths commonly used to suppress the growth of coliforms and enhance the isolation of Salmonella EXCEPT:

   a. Hajna GN broth.
   b. Selenite F broth.
   c. Tetrathionate broth.
   d. Todd-Hewitt broth.

3. The principle ingredient in Kovac's reagent used to detect indole production is:

   a. alpha-naphthol.
   b. polyvinyl alcohol.
   c. p-dimethyl aminobenzaldehyde.
   d. tetramethyl-p-phenylenediamine dihydrochloride.

4. The optimal temperature to demonstrate the motility of Yersinia entercolitica is:

   a. 4°C.
   b. 25°C.
   c. 35°C.
   d. 42°C.

5. The gram negative bacillus that produces a black metallic sheen on Bismuth Sulfite media is:

   a. Escherichia coli.
   b. Klebsiella oxytoca.
   c. Shigella flexneri.
   d. Salmonella typhi.

6. Which biochemical reaction would be most useful to distinguish between Proteus mirabilis and Proteus vulgaris?

   a. citrate utilization.
   b. ornithine decarboxylation.
   c. phenylalanine deamination.
   d. urease hydrolysis.

7. Which biochemical reaction would be most useful to distinguish between anaerogenic strains of Escherichia coli and Shigella species?

   a. acetate.
   b. citrate.
   c. gelatin.
   d. malonate.

8. In order to separate Citrobacter from Salmonella, which biochemical test could be used?

   a. lysine decarboxylation.
   b. lysine deamination.
   c. ornithine decarboxylation.
   d. arginine dihydrolase.

9. Biochemical "kit" procedures used in the identification of Enterobacteriaceae may include all of the following EXCEPT:

   a. API system.
   b. TSI system.
   c. Enterotube system.
   d. Micro-ID system.

10. A motility-indole-ornithine (MIO) tube is observed in which there is growth along the stab to the bottom of the tube. The medium, after 24 hours of incubation, is yellow except for a ring of purple at the top of the tube. What has occurred in this tube during incubation?

    a. Only glucose has been fermented.
    b. Only ornithine has been decarboxylated.
    c. Both glucose and ornithine have been utilized and degraded.
    d. Neither glucose nor ornithine have been utilized or degraded.

11. A positive ONPG test indicates that the organism ferments:

    a. glucose.
    b. lactose.
    c. maltose.
    d. sucrose.

12. After the addition of Kovac's reagent to a tube of SIM medium, a pink color appears. The pink color is due to the presence of:

    a. acetoin.
    b. indole.
    c. nitrate.
    d. tryptophan.

13. Upon the addition of 1N HCl to a DNase plate, a precipitate develops in the agar because the DNA has not been:

    a. hydrolyzed.
    b. oxidized.
    c. decarboxylated.
    d. deaminated.

14. After the addition of Erlich's reagent to a tube of tryptophane broth a pink color appears. A bacterium capable of producing this type of reaction is:

    a. Enterobacter aerogenes.
    b. Escherichia coli.
    c. Proteus mirabilis.
    d. Serratia marcescens.

15. A gram negative bacillus appears as a colorless colony on MacConkey agar and produces an alkaline slant and acid butt in TSI agar after 24 hours of incubation. What sugar(s) does this organism ferment?

    a. glucose only.
    b. glucose and lactose.
    c. lactose and sucrose.
    d. glucose, sucrose and lactose.

16. Yersinia enterocolitica is a non-lactose fermenter, however, many strains when inoculated in a TSI agar produce an acid slant and an acid butt. What can explain this?

    a. It ferments sucrose.
    b. A high acid production causes a pH shift.
    c. It can utilize the peptones in the medium to produce acid.
    d. The organism is infected with a bacteriophage which is capable of breaking down lactose.

17. A gram negative bacillus that produces a yellow butt and a red slant on LIA (Lysine Iron Agar) medium belongs to the genus:

    a. Enterobacter.
    b. Escherichia.
    c. Providencia.
    d. Salmonella.

18. A gram negative bacillus is found to have the following characteristics:

TSI	Alk/Acid , H_2S (-)
lactose	negative
oxidase	negative
phenylalanine	negative
urease	positive
motility	positive at 25°C.
motility	negative at 35°C.

The organism is most likely:

a. Citrobacter diversus.
b. Edwardsiella tarda.
c. Enterobacter cloacae.
d. Yersinia enterocolitica.

19. A gram negative bacillus produces bright mucoid colonies on MacConkey agar and gives the following biochemical reactions:

TSI	Alk/Acid, gas (+), H_2S (-)
LIA	purple/purple
citrate	positive
urease	weakly positive
indole	negative
motility	negative
ornithine	negative

The organism is most likely:

a. Enterobacter agglomerans.
b. Escherichia coli.
c. Klebsiella pneumoniae.
d. Providencia (Proteus) rettgeri.

20. A lactose positive colony from a MacConkey agar is inoculated into a Moeller lysine decarboxylase broth and overlayed with mineral oil. The next day the broth is turbid and purple in color. On the basis of this reaction, it can be said that the organism:

a. produced cadaverine.
b. did not ferment glucose.
c. deaminated to produce putrescine.
d. did not decarboxylate lysine.

21. A lactose negative bacillus was isolated on MacConkey agar from a vaginal culture. The biochemical reactions were:

TSI	Alk/Acid, H_2S (-), no gas
LIA	Red/yellow
indole	positive
citrate	positive
urease	negative
lysine	negative
ornithine	negative
phenylalanine	positive
dulcitol	negative
salicin	negative
adonitol	positive
inositol	positive

The organism can be identified as:

a. Acinetobacter calcoaceticus.
b. Citrobacter freundii.
c. Morganella morganii.
d. Providencia stuartii.

22. The H antigen of the genus Salmonella is equivalent to which antigen of the genus Shigella?

a. capsular.
b. flagellar.
c. somatic.
d. none.

23. A gram negative bacillus is isolated from a sputum. The biochemical reactions are:

TSI	Alk/Alk
oxidase	negative
OF glucose	both tubes are blue
nitrate	red upon addition of zinc dust
motility	negative

The organism is most likely:

a. Pseudomonas aeruginosa.
b. Moraxella species.
c. Flavobacterium meningosepticum.
d. Acinetobacter calcoaceticus var. anitratus.

24. A physician sends a stool to the laboratory with a request for the isolation of Yersinia enterocolitica. What should be done to ensure the recovery of this organism?

  a. Expose the specimen to cold enrichment procedures prior to plating on routine enteric medium.
  b. Plate the specimen to low selectivity enteric differential media and incubate at 25°C for 48 hours.
  c. Subject the specimen to heat shock treatment before plating to routine enteric media and incubate at 25°C for 24-48 hours.
  d. Plate the specimen to routine enteric media and proceed as with other enteric pathogens.

25. Conventional biochemical tests were used by a student in the laboratory for the identification of Enterobacteriaceae. None of the classic reactions occurred with a known organism. Any of the following reasons could explain this result EXCEPT that the:

  a. caps were on too tight.
  b. media were over-inoculated.
  c. media were incubated at 35°C.
  d. media received prolonged incubation.

26. A wound culture reveals a swarming Proteus overgrowing other colonies of bacteria on a blood agar plate. A gram stain indicates that the colonies overgrown are gram negative rods. What medium would isolate these other organisms from the Proteus?

  a. Columbia CNA agar.
  b. MacConkey agar with 5% agar.
  c. Phenylethylalcohol agar.
  d. Salmonella-Shigella agar.

27. A gram negative bacillus is isolated from dialysis fluid. The organism is oxidase positive. What additional tests are required to differentiate this Pseudomonas-like organism from Aeromonas species?

  a. Motility test.
  b. CTA sugars.
  c. OF sugars.
  d. LIA medium.

28. The number of Campylobacter isolates have decreased in the past month. What might be a good explanation for this occurrance?

  a. Incubation at 42°C.
  b. The lack of a 10% CO_2 atmosphere.
  c. The absence of anaerobic conditions.
  d. The presence of a catalyst in the anaerobic jar.

29. A gram negative bacillus is isolated from a neonate. Biochemically the organism resembles Serratia, however, no pigment is produced. What could you do to possible enhance pigment production?

    a. incubate the initial plates at 4°C.
    b. incubate the initial plates at 56°C.
    c. incubate the initial plates another day at 35°C.
    d. inoculate a blood agar plate and incubate it at 25°C.

30. A patient who has travelled in Asia was admitted to the hospital with a rice-water stool. A stool specimen is sent to the laboratory and the technologist realizes that he does not have any TCBS agar. A suitable substitution might be:

    a. Alkaline peptone broth.
    b. GN broth.
    c. Todd-Hewitt broth.
    d. Gelatin-tryptophane broth.

31. A gram negative rod shows a peritrichous flagella when stained. On the TSI slant, it produces an alkaline slant and no change butt. In order to separate Pseudomonas from Alcaligenes you should:

    a. perform a catalase test.
    b. set up OF sugars.
    c. check for growth at 42°C.
    d. check for growth on MacConkey agar.

32. A gram negative bacillus is isolated from a blood culture which give biochemical reactions indicative of a Citrobacter species. In order to speciate this organism, you might set up a(n):

    a. adonitol broth.
    b. methyl red test.
    c. malonate broth.
    d. lysine decarboxylase broth.

33. A burn patient is cultured several weeks after admission and grows a gram negative bacillus. Since Serratia is known to colonize burn victims, which test is the most important procedure that could be used to identify this organism as a Serratia?

    a. Esculin hydrolysis.
    b. DNA hydrolysis.
    c. Voges-Proskauer test.
    d. Glucose oxidation.

34. An amputee is admitted to the hospital exhibiting progressive cellulitis of the stump. A culture of the draining sinus yields a grey, beta-hemolytic colony on sheep blood agar that is oxidase positive and grows well on MacConkey agar. Since the organism ferments glucose, it most likely will be:

    a. TSI -- alkaline/no change.
    b. an Alcaligenes species.
    c. motile by polar flagella.
    d. Eikenella corrodens.

35. A gram negative bacillus isolated from a gall bladder biochemically appears to be a Salmonella typhi. The organism does not agglutinate in the Salmonella polyvalent O antiserum. The next step might be to:

    a. repeat the biochemical tests.
    b. retype with the Salmonella polyvalent O antiserum.
    c. type the organism with Salmonella Vi antiserum.
    d. type the organism with Arizona polyvalent antiserum.

36. An anaerobic gram negative rod that is described as long, thin and tapering probably belongs to the genus:

    a. Bacteroides.
    b. Fusobacterium.
    c. Lactobacillus.
    d. Propionibacterium.

37. To increase the chances for recovery of anaerobes from clinical specimens, any of the following may be tried EXCEPT the use of:

    a. a "gassed out" collection system.
    b. a tight sealing candle jar.
    c. freshly prepared or prereduced media.
    d. media supplemented with Vitamin K and hemin.

38. The catalyst used in the Gas Pak anaerobic jar contains:

    a. aluminum.
    b. carbon dioxide.
    c. hydrogen.
    d. palladium.

39. A metabolic by-product of Propionibacterium acnes as detected by gas chromatography is:

    a. lactic acid.
    b. propionic acid.
    c. pyruvic acid.
    d. succinic acid.

40. A gram negative non-motile bacillus is isolated anaerobically from a blood culture that was hemolyzed and had a foul odor. No growth was observed in the aerobic bottle. These findings are compatible with:

    a. Bacteroides.
    b. Brucella.
    c. Clostridium.
    d. Hemophilus.

41. A microscopic means of characterizing Clostridium species is by:

    a. colonial morphology.
    b. hemolysis on sheep blood agar.
    c. metachromatic granules.
    d. shape and position of spores.

42. A physician has ordered a gastric washing on a newborn. He wants to know if Bacteroides or Clostridium has colonized his patient. Which medium, incubated anaerobically, would be most effective for the isolation of both of these organisms?

    a. Schaedler's blood agar with Vitamin K
    b. K-V Laked blood agar.
    c. Columbia CNA agar.
    d. MacConkey agar.

43. Black colonies on blood agar supplemented with Vitamin K are diagrostic of:

    a. Bacteroides melaninogenicus.
    b. Clostridium perfringens.
    c. Eubacterium distortum.
    d. Fusobacterium nucleatum.

44. The anaerobic gram positive rod that produces lecithinase as observed on Egg Yolk agar, but is negative for lipase is:

    a. Clostridium ramosum.
    b. Clostridium perfringens.
    c. Propionibacterium acnes.
    d. Bifidobacterium eriksonii.

45. Which specimen should not be cultured for anaerobes?

    a. endometrium.
    b. liver abscess.
    c. freshly ruptured appendix.
    d. transtracheal aspiration.

46. A specimen labeled "rectal abscess" is sent to the laboratory. A direct gram stain shows gram positive cocci and gram negative rods. Beta-hemolytic streptococci are isolated on the blood agar plate. Growth plus gas is seen throughout the thioglycollate broth and a foul odor is detected. The genus of the second organism is most likely:

   a. Bacteroides.
   b. Clostridium.
   c. Hemophilus.
   d. Proteus.

47. The direct gram stain of an anaerobic culture shows gram negative rods. On culture only Clostridium perfringens is isolated. What might explain this discrepancy? The organism was

   a. an L-form.
   b. not isolated.
   c. an obligate aerobe.
   d. overdecolorized.

48. An emergency occurs in the laboratory and you are unable to plate an anaerobic culture immediately. What should be done with the specimen to best maintain the viability of the anaerobes that might be in the specimen?

   a. Incubate the specimen at 35°C.
   b. Refrigerate the specimen.
   c. Request another specimen.
   d. Store the specimen at room temperature.

49. An anaerobic culture of a draining mandibular abscess does not grow after two days of incubation. However, the gram stain of the specimen showed branching gram positive rods. The best procedure to follow would be to:

   a. request a new specimen.
   b. reincubate for five more days anaerobically.
   c. reincubate for ten more days aerobically.
   d. send out the report as "No growth in 48 hours."

50. A patient with a liver abscess is admitted to the hospital. The doctor calls the laboratory requesting an anaerobic collection kit in order to collect the specimen properly. If you were out of the collection systems, what alternative would you recommend?

   a. only an aerobic culture be taken at this time.
   b. collect aseptically on a sterile swab and send on dry ice.
   c. send the abscess aspiration in a corked syringe.
   d. request that the doctor obtain culture media from the laboratory for direct plating of the specimen at the patient's bedside.

51. Streptococcus pneumoniae form a green ring around the colonies on blood agar. The greening of the medium is due to:

    a. alpha lysin.
    b. gamma lysin.
    c. lipochrome.
    d. optochin.

52. Blood agar plates when used for the detection of beta hemolytic streptococci are incubated in an atmosphere with reduced oxygen tension because:

    a. Beta streptococci grow best at reduced oxygen tension.
    b. Streptolysin O is oxygen labile.
    c. Streptolysin S is oxygen labile.
    d. Streptolysins O and S are both oxygen labile.

53. Streptococcus viridans is:

    a. alpha hemolytic.
    b. beta hemolytic.
    c. gamma hemolytic.
    d. alpha-prime hemolytic.

54. Oxalated plasma is preferred to citrated plasma in the coagulase test because:

    a. it is readily obtained from the Chemistry laboratory.
    b. oxalate is more readily soluble than citrate.
    c. some bacteria utilize citrate.
    d. some bacteria utilize oxalate.

55. The reagent used in the sodium hippurate hydrolysis test contains:

    a. ferric chloride.
    b. hydrogen peroxide.
    c. sodium chloride.
    d. sodium desoxycholate.

56. Which test would be most helpful in identifying Group D beta hemolytic streptococci?

    a. bacitracin.
    b. bile solubility.
    c. bile esculin hydrolysis.
    d. sodium hippurate hydrolysis.

57. The streptococcal group currently associated with neonatal infection is:

    a. A.
    b. B.
    c. C.
    d. D.

58. Colonies of salt-tolerant Staphylococcus aureus appear on this medium surrounded by a readily visible yellow halo:

a. C.A.M.P.
b. CNA agar.
c. Mannitol salt agar.
d. Bile esculin agar.

59. A gram stain performed on a cervical smear showed gram negative intracellular diplococci. The organism will most likely:

a. be oxidase negative.
b. grow on CNA agar in CO_2 at 35^oC.
c. grow on chocolate agar containing VCN.
d. oxidize glucose and maltose.

60. Which statement is NOT true concerning Hemophilus parainfluenzae?

a. Requires hemin.
b. Requires Factor V only.
c. Grows well on chocolate agar.
d. Satellites around staphylococci on brain heart infusion agar.

61. A number of surveys have shown that a large percentage of the United States population are carriers of Neisseria meningitidis. Which combination of specimen/medium should be used to detect asymptomatic carriers?

a. blood / blood culture media containing hemin.
b. cervical swabs / chocolate agar with VCN.
c. nasopharyngeal swabs / Thayer-Martin medium.
d. throat culture / Columbia CNA agar.

62. Group D streptococci will not grow on MacConkey agar because the medium contains:

a. lactose.
b. neutral red.
c. bile salts.
d. colistin.

63. Which tests would differentiate between alpha hemolytic streptococci and Streptococcus pneumoniae?

a. catalase and bile solubility.
b. esculin hydrolysis and optochin.
c. optochin susceptibility and bile solubility.
d. bacitracin susceptibility and esculin hydrolysis.

64. A catalase positive, gram positive coccus that appeared in masses on gram stain produced the following reactions:

coagulase	negative
mannitol	negative
glucose	negative
DNAse	negative

The organism is most likely:

a. Staphylococcus aureus.
b. Staphylococcus epidermidis.
c. Streptococcus agalactiae.
d. Micrococcus tetragenes.

65. Certain strains of streptococci when grown on sheep blood agar in close proximity to a beta toxin-producing strain of Staphylococcus aureus produce a lytic phenomenon referred to as "arrow head hemolysis". The group of streptococci that is associated with this reaction is:

a. A.
b. B.
c. D.
d. G.

66. A zone of inhibition around an optochin disc that measures 19 mm. in diameter indicates that the organism is most likely:

a. Streptococcus faecalis.
b. Streptococcus pneumoniae.
c. Streptococcus pyogenes.
d. Streptococcus viridans.

67. The extracellular product of Group A streptococci that is NOT inhibited by specific antibodies is:

a. Deoxyribonuclease.
b. Erythrogenic toxin.
c. Streptokinase.
d. Streptolysin S.

68. A vaginal culture is sent to the laboratory for suspected gonococci. The smear shows a 2+ intracellular gram negative diplococci and the chocolate plate shows 3+ growth of suspected gonococci. To confirm the identification of this organism you would:

a. set up CTA sugars.
b. perform a peroxidase test.
c. check for growth on Thayer-Martin medium.
d determine the organism's requirements for X and V factors.

69. All of the following statements are true concerning Branhamella catarrhalis EXCEPT that it:

    a. is oxidase positive.
    b. utilizes dextrose and maltose.
    c. is normal flora in the respiratory tract.
    d. was formerly called Neisseria catarrhalis.

70. A pure culture of a gram positive coccus was isolated from a lesion of the mouth. There are many large, yellowish, opaque, smooth colonies on the sheep blood agar plate. The next step to take in the identification of this organism should be to:

    a. perform a catalase test.
    b. perform a gram stain.
    c. perform a coagulase test.
    d. subculture to a CNA plate.

71. The direct gram stain of a sputum culture reveals many gram positive cocci and numerous pale, thin pleomorphic gram negative rods. Many small alpha hemolytic colonies are seen on the sheep blood agar as well as numerous pinpoint satelliting organisms. In order to better work with these pinpoint colonies, you should subculture the colonies to:

    a. Columbia CNA agar.
    b. Chocolate agar.
    c. Thayer Martin agar.
    d. MacConkey agar.

72. You have isolated an organism from a nasopharygeal culture that was suspicious for Neisseria. The oxidase positive colonies are inoculated to CTA sugars and after 24 hours of incubation you notice that acid is produced in the glucose tube but not in the maltose, lactose or sucrose tubes. You should:

    a. report as presumptive for Neisseria gonorrhoeae.
    b. report as positive for Neisseria meningitidis.
    c. reincubate the sugars for an additional 24 hours.
    d. repeat the CTA sugars.

73. The ideal method of identification of the hemolytic activity of streptococci involves:

    a. holding the plates up against a black background.
    b. holding the plates up against diffused light in order to see through the plate.
    c. having sufficiently thin plates in order to read hemolysis more easily.
    d. microscopic examination of subsurface colonies in a blood agar pour plate.

74. A 5 year old child develops meningitis. The gram stain of the CSF shows many WBCs but no organisms are observed. Your next step might be to:

a. inoculate an anaerobic set up.
b. perform counterimmunoelectrophoresis on the specimen.
c. send the specimen to Chemistry for chromatography studies.
d. suggest a Schultz-Charlton test.

75. A patient is suspected of having pneumococcal bacteremia. After overnight incubation the blood bottles show no visible sign of growth. Routine subculturing is performed after 48 hours of incubation to a chocolate and an anaerobic blood agar plates. At this time the blood appears green and hemolyzed in the blood culture bottle. The subculture plates are no growth at 24 hours. You should conclude:

a. the patient did not have a pneumococcal bacteremia.
b. the organism is a slow grower and requires longer incubation.
c. the organism is fastidious and requires additional supplements for its growth.
d. the prolonged incubation may have resulted in a loss of the organism through autolysis in the fluid medium.

76. Alpha hemolytic gram positive cocci are isolated from a urine culture. Biochemical testing reveals the following: optochin disc--negative; 6.5% NaCl broth--growth; bile esculin slant--black color produced; SF broth--growth and color change. The organism is most likely:

a. resistant to penicillin.
b. susceptible to bacitracin.
c. catalase positive.
d. a contaminant.

77. A physician calls the laboratory to request some Thayer-Martin media for the V.D. clinic, however, the media is back ordered. The best substitution would be:

a. Chocolate agar.
b. Sheep blood agar.
c. Thioglycollate.
d. Transgrow.

78. A patient was diagnosed as having bacterial meningitis. No organisms were seen on direct gram stain of the CSF. A pure culture of a small translucent, beta-hemolytic organism was isolated from blood and CSF cultures. A gram stain revealed tiny gram positive bacilli. A hanging drop preparation demonstrated tumbling motility. The organism would most likely be:

a. catalase positive.
b. coagulase positive.
c. pigmented when grown in the dark.
d. positive when tested for toxigenicity with the Elek test.

79. After 24 hours of incubation, a sputum culture of a patient with pneumonia grew many large mucoid confluent colonies with greening around the colonies. On the blood agar surface the colonies resembled droplets of oil. Upon aging the colonies flattened with a raised margin and depressed central portion. No growth occurred on the MacConkey agar. The next step you would take to identify these colonies would be to:

a. set up an enteric identification system.
b. set up an optochin susceptibility test.
c. suspect Pasteurella and proceed accordingly.
d. suspect Hemophilus parainfluenzae and proceed accordingly.

80. A specimen from a lung abscess was sent to the laboratory for culture. Following 24 hours of incubation, these observations were made:

SBA = gram positive cocci
MacConkey = no growth
Thio = gram positive cocci and gram positive rods

After 48 hours of incubation, the technologist recorded the following:

SBA =gram positive cocci
MacConkey =no growth
SBA(anaerobic) =gram positive cocci, gram positive rods, gram negative rods.
Thio =gram positive cocci, gram positive rods, gram negative rods.

The specimen most likely contained:

a. Clostridium sp., Staphylococcus sp., and Klebsiella sp.
b. Fusobacterium sp., Bacteroides sp., and pneumococci.
c. Pseudomonas sp., Lactobacillus sp., and Veillonella sp.
d. Bacteroides sp., Micrococcus sp., and Clostridium sp.

81. You receive a blood culture from a patient suspected of having Brucella. What would be the best procedure to take to promote the growth of this organism?

a. Use a Castaneda bottle.
b. Use blood culture medium containing cysteine.
c. Subculture the broth to charcoal yeast extract.
d. Subculture the broth to 10% sheep blood agar plate.

82. Rickettsia are gram negative, but do not stain satisfactorily by this method. Best staining results may be achieved by using:

a. an acid fast stain.
b. Dorner's method of gram staining.
c. Giemsa stain.
d. Methylene blue stain.

83. Cysteine blood glucose agar is the media of choice for:

   a. Francisella.
   b. Leptospira.
   c. Pasteurella.
   d. Streptobacillus.

84. A patient is admitted to the emergency room with symptoms of meningitis. Physical examination reveals a small infected wound which according to a family member is the result of a cat bite. Gram stain of the CSF reveals "Very few gram negative rods." With this history you might expect the meningitis due to:

   a. Acinetobacter.
   b. Bordetella.
   c. Pasteurella.
   d. Erysipelothrix.

85. A patient has been on I.V. therapy for 10 days and develops sepsis. Three successive blood cultures grow a gram positive, fat bacillus that appears on blood agar incubated aerobically as large, dull, flat colonies with a typical ground-glass appearance. The organism is most likely:

   a. Corynebacterium.
   b. Erysipilothrix.
   c. Listeria.
   d. Bacillus.

86. Colonies of Mycoplasma grow embedded in the agar. What method would you use to subculture this organism?

   a. Using a sterile pasteur pipette, aspirate the colony.
   b. Scrape the surface of the plate with a sterile loop.
   c. Excise the individual colony with a loop and rub the agar block face down.
   d. Rub the surface of the plate with a sterile cotton swab.

87. Which organism can be diagnosed based on finding characteristic "Donovan Bodies" in large mononuclear cells in Wright stained smears of lesions?

   a. Chlamydia psittaci.
   b. Actinobacillus lignieresii.
   c. Streptobacillus moniliformis.
   d. Calymmatobacterium granulomatis.

88. A physician suspects a case of Legionella pneumophila, however, your laboratory is not equipped to culture for it. You might suggest:

   a. sending blood and sputum specimens to CDC.
   b. consulting the State Department of Health Laboratories.
   c. sending the sputum sample to a veterinary laboratory for animal inoculation.
   d. substituting an L-form broth containing increased sucrose.

89. A farmer develops an infection of the fingers that develops into an erythematous, elevated spreading lesion that is eventually self-limited. On direct gram stain, gram positive rod-shaped organisms are seen that form long filaments. The organism most likely will:

    a. appear as a catalase negative, beta hemolytic colony that is bacitracin sensitive.
    b. appear as a dry, brittle, orange-pigmented colony that is partially acid-fast.
    c. demonstrate a distinctive tumbling motility.
    d. produce a characteristic "test tube brush" type of growth in gelatin medium.

90. Spirochetes can be observed in blood drawn during the initial stage of jaundice disease,and were later observed in urine by Darkfield examination during the second stage of the disease. The organism:

    a. is an obligate anaerobe.
    b. is motile by polytrichous tufts of flagella.
    c. is the causative agent of relapsing fever.
    d. can be cultured in Fletcher's medium.

91. The acid-fast property of Mycobacteria is due to the:

    a. use of methylene blue as a counterstain.
    b. use of carbolfuschin as the primary stain.
    c. presence of caseous particles in the cell wall.
    d. presence of lipoid substances in the cell wall.

92. Using the "cold" modification of the Ziehl-Neelson stain, Mycobacteria will appear as:

    a. blue bacilli against a pink background.
    b. red bacilli against a blue background.
    c. yellow bacilli against a black background.
    d. green bacilli against a red background.

93. In processing routine sputum specimens for Mycobacteria, it is always advisable to:

    a. decontaminate with 2% bovine albumin.
    b. decontaminate with 4% sodium hydroxide.
    c. digest the mucus with tellurite.
    d. digest the mucus with benzalkonium chloride.

94. An acid-fast organism was pigmented when grown in the dark. It also grew at room temperature within 14 days. To which group does this organism most likely belong?

    a. I
    b. II
    c. III
    d. IV

95. Mycobacterium leprae:

    a. is both an animal and a human pathogen.
    b. has been grown on the foot pads of mice.
    c. is the only Mycobacterium that is not acid-fast.
    d. can be grown in vitro on highly enriched artificial media.

96. An acid-fast bacillus has been isolated from the sputum of a patient suspected of having tuberculosis. The organism was colorless when grown in the dark but turned yellow after exposure to light for 30 minutes. This organism is most likely:

    a. M. bovis.
    b. M. kansasii.
    c. M. tuberculosis.
    d. M. intracellulare.

97. Situation: You have ten processed sputum specimens for Mycobacteria. After 24 hours of incubation the slants are contaminated with a gram negative rod. You should:

    a. check to see if the concentration of NaOH was correct.
    b. check the procedure to make sure you added N-acetyl-L-cysteine.
    c. place cultures in the dark to give the Mycobacteria added enhancement for growth.
    d. continue incubation since Mycobacterium will eventually outgrow the contaminant.

98. A hospital dermatology clinic has sent a skin biopsy for "atypical" mycobacteria. You would:

    a. send the specimen to the Mycology laboratory to look for Nocardia.
    b. inoculate a Middlebrook 7H10 and incubate at 37°C in the dark.
    c. inoculate a Lowenstein-Jensen and incubate with increased oxygen.
    d. inoculate two Lowenstein-Jensens and incubate at both 37°C and at room temperature.

99. Situation: A 43 year old female with a history of previous tuberculosis was admitted with chest problems. She had been on prophylactic therapy with INH for 4 years and was faithful to the therapeutic regimen. Cultures were negative at 2,7,10,18 and 24 days. After 28 days one colony that was non-pigmented was observed on the Lowenstein-Jensen medium. Antimicrobial susceptibility testing showed that the organism was resistant to all known TB drugs. The niacin test was negative. The organism is most likely:

    a. M. kansasii.
    b. M. gordonae.
    c. M. fortuitum.
    d. M. avium-intracellulare.

100. A patient has been culture positive for Mycobacterium tuberculosis. In order to remove the patient from isolation, the patient must:

    a. have a negative chest X-ray.
    b. be under appropriate therapy for 7 to 10 days.
    c. wait for the state health department to investigate and make the determination.
    d. have three consecutive sputums that are negative when stained for acid-fast organisms.

101. An infant is admitted to the hospital with diarrhea. In order to isolate an enteric pathogen, the best specimen to collect would be a:

    a. blood culture.
    b. duodenal aspirate.
    c. gastric lavage.
    d. rectal swab.

102. All of the following specimens are suitable for anaerobic culture EXCEPT:

    a. blood.
    b. catheterized urine.
    c. peritoneal fluid.
    d. transtracheal aspirate.

103. The minimum dilution of blood-to-fluid medium in blood culture collection is:

    a. 1:5
    b. 1:10
    c. 1:15
    d. 1:20

104. An anaerobic glove box or chamber uses an atmosphere mixture of:

    a. nitrogen, oxygen, carbon dioxide.
    b. hydrogen, carbon dioxide, helium.
    c. helium, nitrogen, carbon dioxide.
    d. hydrogen, nitrogen, carbon dioxide.

105. The hanging drop technique used in bacterial examinations is to observe bacterial:

    a. capsular formation.
    b. spore production.
    c. morphology.
    d. motility.

106. Isolation techniques include all of the following EXCEPT:

    a. broth culture.
    b. pour plate method.
    c. streak plate method.
    d. calibrated loop technique.

107. Buffered single-substrate media for the identification of nonfermentative gram negative bacilli include a(n):

   a. alcohol, pH buffers and peptones.
   b. acid, a pH indicator and a nitrate source.
   c. amine, a pH indicator and a nitrogen source.
   d. sugar, a pH indicator and phosphate buffer.

108. A sheep blood agar and a MacConkey agar were each inoculated with 0.001 ml of urine. After overnight incubation 50 colonies were observed on each plate. How many colonies/ml. were cultured from the urine?

   a. 50
   b. 1000
   c. 50,000
   d. 100,000

109. Bacteriology plates are incubated in an inverted position to:

   a. keep the organism from spreading.
   b. permit the air to circulate properly.
   c. prevent excess condensation on the colonies.
   d. prevent light from affecting the colony growth.

110. The palladium catalyst used in the "gas pak" anaerobic jar can be reactivated by:

   a. incubating for 24 hours at 56°C.
   b. passing hydrogen gas over the catalyst.
   c. heating in a 160°C oven for two hours.
   d. storing overnight in an airtight container with a dessicant.

111. The majority of biologically useful dyes vary because of the number and arrangement of benzene rings and the substitution of:

   a. carbon.
   b. oxygen.
   c. hydrogen.
   d. nitrogen.

112. A negative stain is useful in observing:

   a. fungal structures.
   b. capsular structures.
   c. parasitic structures.
   d. intracellular structures.

113. A patient's urine culture yielded greater than 100,000 col/ml of Escherichia coli and greater than 100,000 col/ml of Staphylococcus epidermidis. To make sure that this is an infection involving two organisms and not contamination, you might suggest:

a. a catheterized specimen and to repeat the culture.
b. a suprapubic aspiration and to repeat the culture.
c. a clean catch midstream specimen and to repeat the culture.
d. nothing additional. It is not necessary to do any more. Only when three or more organisms are present is contamination suspected.

114. Select the one best combination of media that could be used for the primary plating of an eye drainage:

a. sheep blood agar, chocolate agar, phenylethylalcohol agar.
b. sheep blood agar, Thayer-Martin medium, chocolate agar.
c. sheep blood agar, brain heart infusion broth, chocolate agar.
d. sheep blood agar, Thayer-Martin medium, Columbia CNA agar.

115. The laboratory has a contaminated lot of S-S agar and must substitute a medium for their stool specimens. Which medium would be most suitable?

a. Bismuth Sulfite agar.
b. MacConkey agar.
c. Moeller decarboxylase medium.
d. Xylose lysine desoxycholate agar.

116. In order to obtain a pure culture of a bacterium, a microbiologist could do any of the following EXCEPT:

a. streak to a solid nutrient medium surface.
b. make a series of dilutions on agar plates.
c. inoculate a broth tube with a light inoculum.
d. use an inhibitory medium for other organisms.

117. The electric power which maintains the incubators in a laboratory shuts off and the length of time expected to get the power on again is not known. What is the best emergency procedure?

a. Hold all cultures at room temperature.
b. Move all cultures to a warm area of the laboratory.
c. Transfer all cultures to another obliging laboratory.
d. Leave the incubator closed until the power is returned.

118. A laboratory must substitute a decolorizer for acetone-alcohol in the gram stain procedure for a limited time due to an alcohol shortage. The best substitute would be:

a. ether.
b. acetone.
c. chloroform.
d. ethylene oxide.

119. The antimicrobial agent that inhibits cell wall formation is:

   a. polymyxin.
   b. penicillin.
   c. sulfonamide.
   d. chloramphenicol.

120. The antimicrobial agents that acts by inhibiting protein synthesis is:

   a. ampicillin.
   b. sulfonamide.
   c. cephalosporin.
   d. chloramphenicol.

121. In the Kirby Bauer method of susceptibility testing, the size of the zone of inhibition is determined by correlating zone size with the:

   a. antibiotic content of the disc.
   b. clinical response of the patient.
   c. minimum inhibitory concentration.
   d. achievable bactericidal concentration.

122. The most precise technique for antimicrobial assay is:

   a. turbidimetric.
   b. disc diffusion.
   c. agar diffusion.
   d. radioimmunoassay.

123. All of the following statements concerning penicillin resistance are correct EXCEPT:

   a. The major cause of resistance to penicillin is penicillinase.
   b. Penicillin is not attacked by any other enzyme except penicillinase.
   c. Penicillinase is rapidly produced in some strains of Staphylococcus aureus.
   d. Penicillinase converts the antibiotic to the inactive penicillinoic acid.

124. Which combination would be reasonable to expect from parallel disc and tube susceptibility testing?

   a. resistant to disc, inhibited by low tube concentration.
   b. resistant to disc, inhibited by high tube concentration.
   c. susceptible to disc, inhibited by low tube concentration.
   d. susceptible to disc, inhibited by high tube concentration.

125. A quantitative estimation of antibiotic sensitivity of an organism may be obtained most accurately by:

   a. performing serial dilutions of the antibiotic.
   b. determining the size of the zone of inhibition.
   c. using sensitivity discs containing three concentrations of the antibiotic.
   d. measuring the amount of growth in a single tube of medium containing the antibiotic.

126. Direct susceptibility testing may be performed:

a. routinely on most specimens.
b. when several organisms are expected to grow on culture.
c. when only non-pathogens are expected to grow on culture.
d. on CSF cultures after observing the gram stained smear.

127. The term susceptibility implies that:

a. an infection caused by the strain tested may be expected to respond favorably to the indicated antimicrobial for that pathogen.
b. the strains are not inhibited completely by therapeutic concentrations of the antibiotic.
c. strains may respond to unusually high concentrations of the agent.
d. further testing of alternate antimicrobial agents is warranted.

128. For a serum bactericidal test, the patient's serum should be diluted with:

a. Mueller Hinton broth.
b. normal human serum.
c. inactivated normal human serum.
d. Mueller Hinton broth with normal human serum.

129. Interpreting the results of antimicrobial assays requires a knowledge of all of the following EXCEPT:

a. pharmacokinetics.
b. bactericidal level at the proper dilution.
c. the patient's renal and hepatic functions.
d. the time of the collection of the sample for assay.

130. A patient positive for Neisseria gonorrhoeae is allergic to penicillin. An alternate drug of choice would be:

a. ampicillin.
b. vancomycin.
c. carbenicillin.
d. spectinomycin.

131. A steady decrease in zone sizes obtained with a control organism in antibiotic susceptibility testing might be corrected by:

a. replacing discs.
b. changing media lot.
c. standardizing the inoculum.
d. resubculturing the control organism.

132. A patient with an infection due to Pseudomonas aeruginosa did not respond well to treatment with tobramycin after the laboratory had reported a low MIC. The inaccuracy of the test maybe due to a media deficiency of:

a. Na^+
b. Cl^- and CO_3^-
c. Ca^{++} and Mg^{++}
d. K^+

133. Hemophilus influenzae cultures were suddenly resistant only to ampicillin. The most likely explanation of this occurrence might be that:

a. the discs were stored at refrigerator temperatures.
b. the discs were stored with a dessicant.
c. beta-lactamase positive strains were being isolated.
d. the chocolatized Mueller-Hintons were poured too thin.

134. The primary purpose of performing gentamicin assays is to prevent toxic levels in the patient that would result in:

a. liver damage.
b. potential heart damage.
c. respiratory complications.
d. potential cranial nerve toxicity.

135. Therapy will probably be adequate for infective endocarditis if the peak serum concentrations are:

a. bactericidal at a 1:8 dilution.
b. bactericidal in the patient's undiluted serum.
c. bacteriostatic at a 1:1 dilution.
d. bacteriostatic at a 1:16 dilution.

136. The most effective method of sterilizing Trypticase Soy agar is:

a. boiling.
b. dry heat.
c. live steam.
d. steam under pressure.

137. Morbidity rate of a disease refers to:

a. the rapidity with which infected persons expire.
b. the rapidity with which infected persons become ill.
c. the ratio of sick-to-well persons with a given disease.
d. the ratio of deaths from a given disease to the number of cases with that disease.

138. A most frequent nosocomial infection involves:

a. surgical wounds.
b. the urinary tract.
c. the respiratory tract.
d. the gastrointestinal tract.

139. Quality assurance records should be kept for a period of:

- a. 1 month.
- b. 1 year.
- c. 2 years.
- d. 5 years.

140. The efficacy of a disinfectant is determined by testing its ability to kill a test organism and comparing it under similar conditions with the action of:

- a. HCl.
- b. NaOH.
- c. phenol.
- d. acetone.

141. The most likely reason that smallpox will sometime be eliminated is that:

- a. it is losing its virulence.
- b. it lacks an animal reservoir.
- c. man is becoming increasingly immune.
- d. a vaccine gives complete protection.

142. A survey of dietary personnel using hand imprints on contact agar plates is:

- a. of no value and should not be practiced.
- b. of value as a teaching method to encourage handwashing.
- c. an excellent means of identifying carriers of Staphylococcus aureus.
- d. a reliable method of quantitating staphylococci and testing for toxigenic strains.

143. An epidemiological study is planned on an outbreak of Serratia infections in the urology section of a hospital. The most readily available laboratory aid that is used for this type of study is:

- a. serotyping.
- b. the antibiogram.
- c. endotoxin typing.
- d. bacteriophage typing.

144. For high quality media, it is advisable to use carefully distilled water since most water supplies contain:

- a. trace acids.
- b. some bacteria.
- c. particles and debris.
- d. minerals, especially copper.

145. The temperature range for microbiology refrigerators and incubators should be ______ °C and _____ °C respectively.

a. 0-10; 25-35.
b. 10-20; 35-37.
c. 2-8; 34-36.
d. 0-4; 30-35.

146. After preparing 100 plates of XLD agar, it is noticed that a precipitate has formed in the plates. The cause of this phenomenon could be that:

a. outdated dehydrated medium was used.
b. too little water was used to rehydrate the medium.
c. tap water was used instead of distilled water to rehydrat .
d. the media was held too long at 50°C before pouring into petri dishes.

147. If medium containing a sugar is subjected to excessive autoclaving, the medium is:

a. alright to use as long as it is labelled that it was sterilized incorrectly.
b. to be cooled rapidly to counteract the heating process.
c. still acceptable providing the color looks alright.
d. decomposed and therefore unacceptable for use.

148. A patient with meningococcal meningitis is admitted to a hospital. Persons who came in contact with this patient are generally given:

a. sulfonamide.
b. rifampin.
c. sulfonamide to only close contacts.
d. rifampin to only close contacts.

149. The best method to quality control a wound specimen that is received in the laboratory would be:

a. by proficiency testing the personnel periodically.
b. to plate stock organisms to a similar set of media.
c. to perform daily quality control on all reagents and equipment utilized.
d. to gram stain the specimen and correlate the results with the growth obtained.

150. A student tells you he has received a slight electrical shock from a centrifuge while removing some specimens from it. You should:

a. reverse the polarity of the electrical plug.
b. have the centrifuge examined for a faulty ground connection.
c. instruct all personnel to dry their hands well before using the centrifuge.
d. touch the centrifuge to see whether it was static electricity or the result of a "hot" chassis.

151. Members of the division Eumycota are unable to manufacture their own food because they lack:

a. chlorophyll.
b. enzymes.
c. minerals.
d. vitamins.

152. An agent of the Zygomycete class that lacks rhizoids but still causes disease is:

a. Absidia.
b. Cumminghamella.
c. Mucor.
d. Rhizopus.

153. A cream colored, pasty, smooth colony is seen on cornmeal-tween 80 agar. Upon microscopic observation thick walled terminal structures are seen on the pseudohyphae. These structures are called:

a. cleistothecia.
b. chlamydospores.
c. blastospores.
d. ascospores.

154. A fungus that grows only as an encapsulated yeast at 37°C and room temperature and that is very neurotropic in debilitated or compromised hosts is:

a. Candida albicans.
b. Torulopsis glabrata.
c. Histoplasma capsulatum.
d. Cryptococcus neoformans.

155. The slide culture technique has one primary advantage over other fungal slide preparations in that it:

a. is suitable for rapid diagnostic work.
b. can be used for tube and plate specimen mounts.
c. requires minimal reagents and materials to set up.
d. preserves the microscopic structures of the specimen.

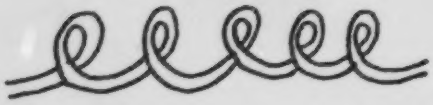
156. A rapidly growing fungi that produces brillantly colored colonies on Sabouraud Dextrose agar may be identified as belonging to which group of fungi?

a. dimorphic.
b. dematiaceous.
c. Dermatophytes.
d. Zygomycete.

157. A fluffy, white, filamentous mold that grows on brain-heart infusion agar supplemented with antibiotics is recovered in the laboratory at 25°C. The fungi fail to convert at 37°C to a yeast. Upon microscopic examination arthroconidia are seen. The organism is most likely:

a. Blastomyces dermatitidis.
b. Trichosporon capitatum.
c. Coccidioides immitis.
d. Geotrichum candidum.

158. A dermatophyte that can invade the hair shaft produces the hyphal morphology as illustrated below when grown on cornmeal agar. Many microaleurospores are also observed. The organism can most likely be identified as:



a. Epidermophyton floccosum.
b. Microsporum canis.
c. Trichophyton mentagrophytes.
d. Trichophyton rubrum.

159. A heaped, folded, glabrous, orange colony is isolated from a transtracheal aspiration. The filamentous colony is gram positive and gives a positive reaction when stained with Hank's acid-fast stain. The delicate, branching organism grows on Lowenstein-Jensen in 9 days and the intertwining filaments quickly fragment into bacillary and coccoid forms. The organism can be identified as:

a. Actinomyces.
b. Mycobacterium.
c. Nocardia.
d. Streptomyces.

160. A brown pigment is observed on caffeic acid agar. The organism is:

a. Candida albicans.
b. Rhodotorula glutinis.
c. Histoplasma capsulatum.
d. Cryptococcus neoformans.

161. A cream colored fungus grows on primary culture media in 3 days. The germ tube technique reveals appendages ½ the width of and three times the length of the cell wall from which they arose. The sucrose assimiliation reaction is negative. The organism is most likely:

a. Candida albicans.
b. Candida tropicalis.
c. Candida parapsilosis.
d. Candida stellatoidea.

162. A patient with Lupus Erythematosus is showing clinical symptoms of a cryptococcal septicemia. The physician orders a latex agglutination test for cryptococcosis. The patient has a titer of 1:4 and the negative control was also 1:4. The technologist should interpret the results as:

    a. negative for Cryptococcus.
    b. positive for Cryptococcus.
    c. positive for nonspecific interference.
    d. invalid due to nonspecific interference.

163. A lesion from the oral cavity grows a white, moist, yeast-like colony at 25°C in 4 days. The microscopic morphology reveals rectangular arthroconidia with rounded ends. It assimilates only glucose, galactose and xylose and is urease negative. The probable identification is:

    a. Geotrichum candidum.
    b. Torulopsis glabrata.
    c. Coccidioides immitis.
    d. Candida parapsilosis.

164. A keratinizing infection of Tinea capitis is caused by one of two Microsporum species. What is the best criterion that the technologist should use to differentiate these two organisms?

    a. growth on rice medium.
    b. presence of microaleurospores.
    c. fluorescence with a Wood's lamp.
    d. incubation temperature variation.

165. A cornmeal slide culture test reveals a yeast colony that does not form hypha, however, widely spaced blastospores are observed. What three tests would best speciate this organism?

    a. bird seed agar, germ tube and nitrate test.
    b. nitrate test, germ tube and inositol assimilation.
    c. urease, galactose fermentation and germ tube reaction.
    d. inositol assimilation, urease, bird seed agar pigmentation.

166. A student wishes to observe the microscopic morphology of a white moist, yeast-like colony that he believes to be Cephalosporium. Repeated tease preparations reveal only long delicate phialides with scattered conidia. What should the student do to correctly observe the specimen's true microscopic morphology?

    a. set-up a scotch-tape test.
    b. prepare a slide-culture preparation.
    c. ask a technologist to set-up the tease mount.
    d. inoculate a new cornmeal agar plate and repeat the tease prep.

167. A horticulture student stuck her finger on a thorn and a lesion developed. A culture reveals a wrinkled tan colony on Sabouraud dextrose agar that on further incubation turns black. Direct examination of the exudate shows cigar-shaped yeast-like forms. The organism is most likely a:

a. dermatophyte.
b. dimorphic fungus.
c. saprophytic yeast.
d. maduromycotic agent.

168. A patient employed as a park caretaker develops symptoms of meningitis. A moist, flat, cream colored colony is isolated on Sabouraud dextrose agar in 4 days. Thick-walled budding yeast are observed from his blood and urine. A rapid presumptive identification of this organism can be made by performing a(n):

a. KOH preparation.
b. Slide culture mount.
c. India ink preparation.
d. Periodic Acid Schiff stain.

169. The laboratory receives a sterile syringe containing pus removed from a closed chronic sinus tract lesion. Yellow granules are visible in the fresh mount. The physician has requested a fungus culture. The technologist should adjust the culturing procedure to include:

a. corn meal agar.
b. anaerobic incubation.
c. incubation at 25°C and 37°C.
d. media containing cycloheximide.

170. A specimen from a skin infection is sent to the laboratory for a KOH mount. Two fungal forms are observed in the infected skin--short, aborative hyphae and clusters of spherical, budding yeast cells. The fungus does not grow on any fungal media. The etiological agent is most likely:

a. Malassezia furfur.
b. Microsporum canis.
c. Trichophyton tonsurans.
d. Trichophyton schoenleinii.

171. Parasitized animals that may serve as a source of infection to man are referred to as a(n):

   a. vector.
   b. direct host.
   c. reservoir host.
   d. intermediate host.

172. Size is the main, if not the only, morphological criterion for distinguishing Entamoeba histolytica trophozoites from:

   a. Entamoeba coli.
   b. Endolimax nana.
   c. Entamoeba polecki.
   d. Entamoeba hartmanni.

173. The motility of the Chilomastix mesnili trophozoite is described as:

   a. falling leaf movement.
   b. rapid, jerky movement.
   c. rolling, directional movement.
   d. rapid, directional movement.

174. The nematode whose ovum is asymmetrically flattened on one side, with a transparent shell that usually contains a fully developed larvum is:

   a. Toxocaris canis.
   b. Trichuris trichiura.
   c. Necator americanus.
   d. Enterobius vermicularis.

175. The trematode ovum that has a prominent terminal spine is:

   a. S. mansoni.
   b. S. japonicum.
   c. S. haematobium.
   d. P. westermani.

176. The arthropod which serves as the vector for endemic typhus and trench fever is a:

   a. mite.
   b. tick.
   c. louse.
   d. mosquito.

177. Recovery of parasites in the zinc sulfate concentration method depends on the controlled specific gravity of the solution. It should be maintained at:

   a. 1.081
   b. 1.108
   c. 1.180
   d. 1.810

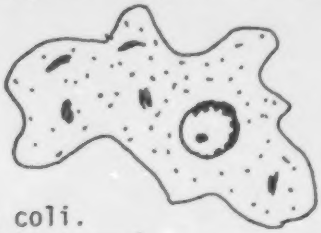
178. Reliable diagnosis of a parasitic infection in a patient necessitates preliminary information regarding the:

a. age of the patient.
b. eosinophil count.
c. site of the parasite in the host.
d. water or food source.

179. Lesions found in the mucosal lining of the cecum and rectosigmoidal areas of man are most likely caused by the penetrating trophozoites of:

a. Giardia lamblia.
b. Balantidium coli.
c. Trichomonas hominis.
d. Entamoeba histolytica.

180. The amoebic trophozoite pictured belong is most likely:



a. Entamoeba coli.
b. Entamoeba hartmanni.
c. Endolimax nana.
d. Iodamoeba bütschlii.

181. A small, oval protozoan cyst with smooth cytoplasm and 4 nuclei containing blot-like karyosomes can most likely be identified as:

a. Endolimax nana.
b. Iodamoeba bütschlii.
c. Chilomastix mesnili.
d. Dientamoeba fragilis.

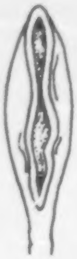
182. A trophozoite that has one nucleus found at the broad end of a pear-shaped body, an axostyle extending through the posterior end, and an undulating membrane extending mid-distance the length of the organism describes:

a. Chilomastix mesnili.
b. Trichomonas vaginalis.
c. Trichomonas tenax.
d. Trypanosoma cruzi.

183. Fifty percent of the red blood cells in a thin blood smear contain ring forms of a Plasmodium. No maturing schizonts or gametocytes are seen. The patient is experiencing paroxysms which occur at irregular intervals. The causative agent is most likely:

a. Plasmodium vivax.
b. Plasmodium ovale.
c. Plasmodium malariae.
d. Plasmodium falciparum.

184. The adult tapeworm attaches to the upper small intestinal wall and competes with the host for Vitamin B12. During treatment the scolex is recovered and is pictured below. The cestode can be identified as:

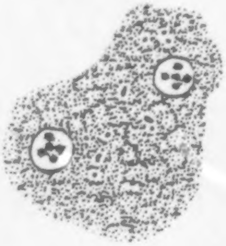


a. Taenia solium.
b. Taenia saginata.
c. Hymenolepis nana.
d. Diphyllobothrium latum.

185. Chilomastix mesnili is identified in the stool of a diarrhetic patient. What is the significance of this identification by the laboratory?

a. The organism is a cause of dysentery.
b. It is probably a contaminant from the laboratory tap water.
c. The organism is a yeast commonly confused with intestinal protozoa.
d. The organism, although nonpathogenic, indicates contact with contaminated water or food.

186. A trichrome stain revealed the organism pictured below. It exhibits fragmented karyosomes, no visible peripheral chromatin and has a very vacuolated cytoplasm. This organism is most likely:

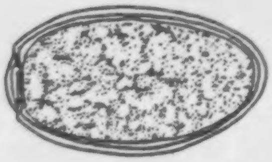


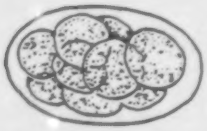
a. Entamoeba coli.
b. Endolimax nana.
c. Entamoeba hartmanni.
d. Dientamoeba fragilis.

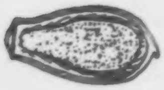
187. In order to prevent the disintegration of intestinal amoeba when staining, it is recommended that a portion of the specimen be mixed with:

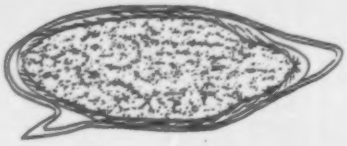
a. formalin.
b. formalin-saline.
c. polyvinyl alcohol.
d. merthiolate-iodine.

188. The diagnostic stage of the Oriental lung fluke would appear as:

a. 

b. 

c. 

d. 

189. Trichomonas hominis can be differentiated from Trichomonas vaginalis by:

a. their cyst stages.
b. the number of anterior flagella.
c. length of the undulating membrane.
d. position of the nucleus.

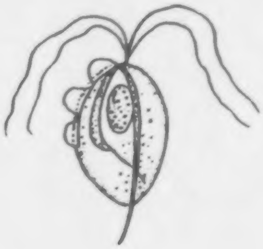
190. A patient is requested to submit stool specimens for ova and parasites, however, he is unable to produce a specimen. You might suggest a saline purge using:

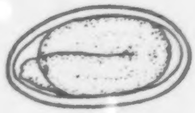
a. mineral oil.
b. barium compound.
c. a laxative.
d. Fleet Phospho-soda.

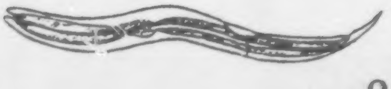
191. Your laboratory ran out of PVA fixative to supply to clinic for out-patient stool collection for parasites. You could substitute all of the following EXCEPT:

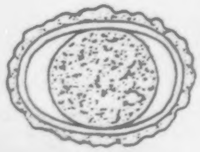
a. 10% formalin.
b. Schaudinn's fixative.
c. iron hematoxylin.
d. an empty vial.

192. When reading a cellophane tape preparation, the technologist is looking for the following structure:

a. 

b. 

c. 

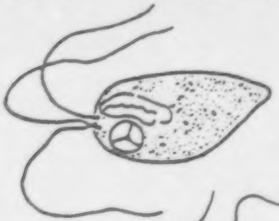
d. 

193. There are numerous ova characterized by their very thick, mammillated shell present in a stool specimen. Which statement is true concerning this organism?

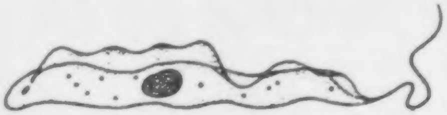
a. The mode of infection is penetration of the skin.
b. Larvae of this organism possess six hooklets for attachment.
c. The organism can produce hydatid cysts in the lungs of man.
d. Diagnosis may also be made by recovery of infertile eggs of this worm.

194. The pathogenic flagellate which infects the duodenum and may frequently be recovered in duodenal washings appears as:

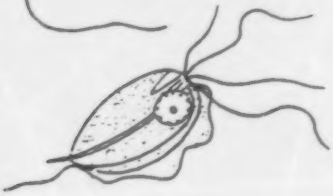
a.



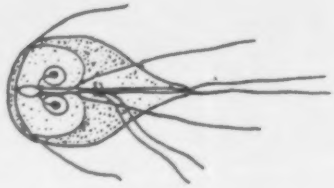
b.



c.



d.



195. A stool left at room temperature for 4 hours containing Hookworm ova could later be incorrectly identified as:

a. Necator americanus.
b. Ancyclostoma duodenale.
c. Ascaris lumbricoides.
d. Strongyloides stercoralis.

196. A technologist examines 2 consecutive stool specimens from a patient for ova and parasites. In stool #1, amoebic trophozoites are found. In stool #2, many amoebic cysts are seen. The most probable explanation is:

a. The organism is becoming more virulent.
b. The second stool was improperly stained.
c. The first stool was watery, the second was formed.
d. One stool was mislabelled and could belong to another patient.

197. On a direct wet preparation of a diarrhetic stool, an organism is identified as an amoeba. The next step should be to:

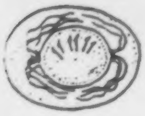
a. report as Entamoeba histolytica.
b. report as positive for amoebic dysentery.
c. request a repeat specimen for confirmation.
d. perform a trichrome stain for identification.

198. A patient was instructed to bring her stool specimen to the laboratory each day for 3 days, preferably in the morning. She was unable to produce a specimen in the morning, and after breakfast used a suppository to induce bowel activity. Upon examination, the technologist reported the specimen unsatisfactory for examination because:

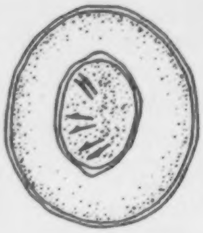
a. oily substances obscure ova and parasites.
b. liquid stools are difficult to concentrate.
c. too much food debris present to adequately examine.
d. artificial cathartic substances disintegrate parasites.

199. The two structures below were seen on an iodine preparation of a concentrated stool specimen:

I



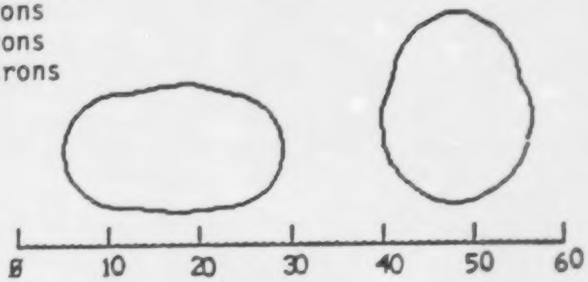
II



a. I is an artifact,
   II is Hymenolepis ovum.
b. I and II are both Diphyllobothrium ova.
c. I is an artifact, II is a hydatid sand.
d. I and II are both Hymenolepis ova.

200. The parasite sketched below was located while scanning a direct fecal smear under low power magnification. The technologist switched to the high dry objective and is about to take a measurement. What are the dimensions of the parasite?

10 x 1 ocular unit = 9.5 microns
40 x 1 ocular unit = 2.5 microns
100 x 1 ocular unit = 0.97 microns



a. 22 microns x 16 microns
b. 29 microns x 15.5 microns
c. 60 microns x 40 microns
d. 21 millimeters x 15 millimeters

MT - B

1. Triple Sugar Iron agar is a Kligler's Iron agar with the addition of 1%:

   a. glucose.
   b. lactose.
   c. sucrose.
   d. maltose.

2. The bacterial enzyme tryptophanase breaks down tryptophan to produre:

   a. ammonia.
   b. acetoin.
   c. indole.
   d. lactic acid.

3. A selective medium for the isolation of Salmonella is:

   a. McBride's agar.
   b. MacConkey agar.
   c. Eosin Methylene blue agar.
   d. Xylose lysine desoxycholate agar.

4. The optimal temperature to induce pigment production of organisms is:

   a. 4°C.
   b. 25°C.
   c. 35°C.
   d. 42°C.

5. Members of the family Enterobacteriaceae characteristically:

   a. ferment glucose.
   b. ferment lactose.
   c. liquify gelatin.
   d. produce indole.

6. The biochemical reaction most useful to differentiate Arizona from Salmonella is:

   a. acetate.
   b. citrate.
   c. gelatin.
   d. malonate.

7. The biochemical test most useful to distinguish between Serratia and Enterobacter is:

   a. DNAse.
   b. lysine.
   c. salicin.
   d. ornithine.

8. The enteric gram negative bacillus most frequently isolated from urine cultures is:

    a. Proteus vulgaris.
    b. Klebsiella pneumoniae.
    c. Pseudomonas aeruginosa.
    d. Escherichia coli.

9. Using a flagellar stain, peritrichous bacterium would appear as having flagella

    a. grouped in tufts.
    b. at both ends of the cell.
    c. at one end of the cell only.
    d. surrounding the entire cell.

10. In the nitrate reduction test, a red color develops only after the addition of zinc dust to the reaction. This would indicate that the bacterium:

    a. produces nitrogen gas.
    b. reduced nitrate to nitrite.
    c. reduced nitrate to nitrous oxide.
    d. failed to reduce nitrate to nitrite.

11. The production of a purple butt on LIA indicates that the organism growing the medium has converted the lysine to:

    a. ornithine.
    b. cadaverine.
    c. putrescine.
    d. an acid.

12. A gram negative rod that produces an alkaline slant and no change butt in TSI medium is capable of fermenting:

    a. glucose only.
    b. glucose and lactose but not sucrose.
    c. glucose and sucrose but not lactose.
    d. neither glucose, sucrose nor lactose.

13. A positive ONPG test would detect a :

    a. slow sucrose fermenter.
    b. slow lactose fermenter.
    c. rapid glucose fermenter.
    d. rapid lactose fermenter.

14. After the addition of alpha napthol and 10% KOH to an inoculated tube of MR-VP medium, a pink color develops. A bacterium that produces this type reaction is:

    a. Escherichia coli.
    b. Proteus vulgaris.
    c. Enterobacter aerogenes.
    d. Morganella morganii.

15. A gram negative bacillus appears as a colorless colony on MacConkey agar. On Kligler's iron agar it produces an alkaline slant and acid butt. From this we can conclude that the organism ferments:

    a. glucose only.
    b. glucose and lactose.
    c. glucose and sucrose.
    d. neither glucose nor lactose.

16. A gram negative bacillus on TSI agar produces acid/acid. Ornithine and lysine are decarboxylated. The organism is adonitol negative and hydrolyzes deoxyribonucleic acid. The organism belongs to the genus:

    a. Serratia.
    b. Klebsiella.
    c. Escherichia.
    d. Enterobacter.

17. A gram negative bacillus produces a red slant and yellow butt on Lysine Iron Agar (LIA). The organism belongs to the genus:

    a. Proteus.
    b. Serratia.
    c. Shigella.
    d. Yersinia.

18. Three blood cultures on a patient grow a gram negative bacillus that is colorless on MacConkey agar. The following biochemical reactions occurred:

TSI	Alk/Acid, H_2S (+)
LIA	purple/purple
ONPG	negative
MR	positive
VP	negative
Citrate	positive
ornithine	positive
malonate	negative

    The organism is most likely:

    a. Arizona.
    b. Shigella.
    c. Citrobacter.
    d. Salmonella.

19. A gram negative rod from a urine culture produces the following biochemical results:

TSI	Acid/Acid, no gas, H_2S (+)
LIA	red/yellow
indole	positive
ornithine	negative
motility	positive
urease	positive
citrate	positive

The organism is most likely:

a. Proteus vulgaris.
b. Proteus mirabilis.
c. Morganella morganii.
d. Providencia rettgeri.

20. A lactose negative bacillus is isolated from the stool on a MacConkey and SS agar. The biochemical reactions are:

TSI	Alk/Acid, H_2S (+)
Indole	positive
lysine	positive
ornithine	positive
citrate	negative
urease	negative
dulcitol	negative
salicin	negative
adonitol	negative

The organism is most likely:

a. Proteus mirabilis.
b. Citrobacter freundii.
c. Edwardsiella tarda.
d. Yersinia enterocolitica.

21. A lactose negative bacillus isolated from a wound gave the following biochemical reactions:

TSI	Alk/Alk, H_2S (+)
OF glucose	oxidative
oxidase	positive
motility	positive
pigments	none

The organism is most likely:

a. Pseudomonas putida.
b. Aeromonas hydrophila.
c. Pseudomonas putrefaciens.
d. Pseudomonas aeruginosa.

22. A gram negative bacillus is isolated from a blood culture bottle that grows as a greenish scum on the surface of the bottle. The organism grows on blood agar as a feathery colony producing marked greenish hemolysis and has a sweet odor. On EMB the organism is a non-lactose fermenter. The organism is most likely:

    a. Enterobacter sakazakii.
    b. Serratia marcescens.
    c. Flavobacterium meningosepticum.
    d. Pseudomonas aeruginosa.

23. A gram negative bacillus from a stool biochemically is consistant with Shigella. The organism is tested with Shigella polyvalent O antiserum. No agglutination occurs, but after heating the suspension the organism agglutinates with Shigella Group B antisera. This indicates that:

    a. The organism is Shigella flexneri.
    b. The organism contains a heat stable envelope antigen.
    c. The organism is anaerogenic Escherichia coli.
    d. The antiserum is weak and needs to be replaced.

24.. The laboratory is out of EMB plates. You are requested to prepare a 100 plates of an alternative medium. Listed below are dehydrated media that are on hand. Which one should you use?

    a. Xylose Lysine Desoxycholate agar.
    b. Salmonella-Shigella agar.
    c. He toen Enteric agar.
    d. MacConkey agar.

25. A wound culture reveals a swarming Proteus overgrowing other colonies on a blood agar plate. The gram stain indicates that these colonies are gram negative rods. What medium would isolate these organisms?

    a. Selenite Broth.
    b. Columbia CNA agar.
    c. Field's enrichment agar.
    d. Eosin Methylene blue with 5% agar.

26. A gram negative rod produces small-to-tiny colonies frequently situated in shallow craters in the agar, is nonmotile, and oxidase positive. The most likely identification of this organism is:

    a. Eikenella corrodens.
    b. Moraxella osloensis.
    c. Alcaligenes faecalis.
    d. Acinetobacter calcoaceticus var. lwoffii.

27. Pyocyanin and fluorescein are:

    a. enzymes produced by members of the genus Acinetobacter.
    b. pigments produced by Pseudomonas aeruginosa.
    c. media used in the differentiation of minute gram negative rods.
    d. degradation products of Achromobacter on cetrimide agar.

28. Campylobacter fetus ss. jejuni can be isolated from rectal swabs directly plated to Campy-BAP or:

    a. an enrichment broth such as tetrathionate broth before subculturing to Campy-BAP.
    b. concentrated from stools that are extracted with acetone and centrifuged prior to plating.
    c. indirectly after overnight refrigeration of the specimen in Campy-thio, then subcultured to Campy-BAP the next day.
    d. streaked heavily on TCBS or TTGA and incubated at 42°C for 18 to 24 hours.

29. The gram negative, oxidase positive, coccobacilli that can be easily confused with Neisseria gonorrhoae from genitourinary sources is:

    a. Pseudomonas putida.
    b. Pseudomonas cepacia.
    c. Moraxella osloensis.
    d. Acinetobacter calcoaceticus.

30. A patient who had travelled in Asia was admitted to the hospital with a rice-water stool. A stool specimen is sent to the laboratory with a request to look for Cholera. The laboratory generally sets up Alkaline Peptone Broth culture to isolate the organism, however, the supply on hand is contaminated. A suitable substitute that you might borrow from another hospital might be:

    a. desoxycholate citrate agar.
    b. GN broth.
    c. broth containing 7% to 10% NaCl.
    d. Thiosulfate-citrate-bile salt-sucrose agar.

31. A nonmotile, gram negative, lactose-fermenter is isolated from a sputum culture. The organism will most likely be:

    a. methyl red positive.
    b. citrate negative.
    c. lysine decarboxylase negative.
    d. a weak urease producer.

32. Two organisms that deaminate lysine and phenylalanine and that are urease negative can be differentiated by the reaction obtained on two sugars:

    a. arabinose and salicin.
    b. adonitol and inositol.
    c. dulcitol and adonitol.
    d. xylose and arabinose.

33. When a blood culture is positive, the broth may assume an appearance that may give the microbiologist a clue to its identity. For example gram negative enteric organisms:

    a. form a large jelly-like coagulum throughout the broth.
    b. produce uniform turbidity with gas bubbles often present.
    c. form a thick pellicle on the surface of the medium with gross hemolysis produced.
    d. appear as "cotton ball" colonies on the top of the sediment of red cells.

34. A physician complains that the laboratory has not isolated Salmonella typhi from the stool of a patient with a classic case of Typhoid Fever. You explain to the physician that the ideal specimen for the isolation of S. typhi during the first week of illness is a:

    a. rectal swab.
    b. blood culture.
    c. urine culture.
    d. gastric lavage.

35. A gram negative bacillus from a stool culture biochemically identifies as a Salmonella. A slide agglutination test using a saline suspension of the organism and Salmonella polyvalent antiserum shows no agglutination. What would be the next step?

    a. reinoculate the biochemical tests.
    b. subculture the organism to a blood agar plate.
    c. report out as "No enteric pathogens isolated."
    d. retest using a heated suspension of the organism.

36. An anaerobic gram positive rod is isolated from a peritoneal abscess. The gram stain reveals occasional subterminal spores. To which genus does the organism belong?

    a. Bacillus.
    b. Bacteroides.
    c. Clostridium.
    d. Eubacterium.

37. In order to ensure the growth of Bacteroides melaninogenicus on anaerobic prereduced media, the media should contain:

    a. hemin and Vitamin A.
    b. hemin and Vitamin K.
    c. Vitamin K and menadione.
    d. horse blood and kanamycin.

38. The medium of choice for the detection of alpha toxin in Clostridium perfringens is:

    a. Cooked Meat Broth.
    b. Columbia CNA agar.
    c. Egg Yolk agar.
    d. Laked KV agar.

39. Pitting on blood agar plates is characteristic of the anaerobic organism:

    a. Bacteroides tetani.
    b. Bacteroides fragilis.
    c. Bacteroides corrodens.
    d. Bacteroides melaninogenicus.

40. A swab is obtained from an oral infection and cultured aerobically and anaerobically. The organism only grows under anaerobic conditions. The colonies are small, translucent and have no odor. The gram stain shows gram negative cocci in pairs, short chains and irregular clumps. The most probable genus is:

    a. Neisseria.
    b. Veillonella.
    c. Peptococcus.
    d. Peptostreptococcus.

41. Peptococcus is tested for catalase by the same technique as for staphylococci, except that Peptococcus cultures must be:

    a. tested on blood agar only.
    b. tested with 30% hydrogen peroxide.
    c. exposed to air for ½ hour before testing.
    d. exposed to hydrogen peroxide vapors in the testing procedure.

42. A patient is expected to have a mixed infection of Clostridium and Bacteroides. Which medium, incubated anaerobically, would you use to isolate the Clostridium from the Bacteroides?

    a. MacConkey agar.
    b. Columbia CNA agar.
    c. K-V Laked Blood agar.
    d. Schaedler's blood agar with Vitamin K.

43. An anaerobic jar is incubated for 24 hours. After this time, the indicator strip has remained blue. What conclusion could be made from this observation?

    a. The jar is air-tight.
    b. Anaerobic conditions were not obtained.
    c. The indicator strip is supposed to remain blue.
    d. Prolonged incubation affected the indicator strip.

44. An anaerobic gram positive rod that is isolated from a blood culture does not produce spores to aid in the identification. Which medium should be utilized to enhance this characteristic:

    a. Cooked Meat Medium.
    b. Todd Hewitt Medium.
    c. Thioglycollate Medium.
    d. Peptone-Yeast-Glucose Medium.

45. On anaerobic enriched blood agar, a colony of a Bacteroides species exhibits a brick red color under ultra-violet light. The organism is most likely:

    a. Bacteroides oralis.
    b. Bacteroides corrodens.
    c. Bacteroides fragilis.
    d. Bacteroides melaninogenicus.

46. A specimen from an ulcerative decubitus is sent to the laboratory. A gram stain shows gram positive cocci and gram negative rods. Proteus mirabilis grows on the sheep blood agar and MacConkey agar aerobically. There is no growth on the aerobic Columbia CNA agar. Growth plus gas is seen throughout the thioglycollate broth. The genus of the second organism could be:

    a. Micrococcus.
    b. Bacteroides.
    c. Actinomyces.
    d. Peptostreptococcus.

47. The gram stain of a brain abscess shows numerous gram negative pleomorphic bacilli with some vacuolation. The aerobic cultures, planted to sheep blood agar, chocolate and MacConkey agar are "No growth". The organism:

    a. is a facultatively anaerobic organism.
    b. is resistant to Penicillin.
    c. can be induced to sporulate.
    d. produces only propionic acid as its metabolic by-product of glucose.

48. A fusiform gram negative rod is isolated both on Schaedler's Blood agar and KV blood agar. The laboratory generally used a rapid anaerobic identification system that employs biochemicals. What method could be substituted as a back-up procedure for this organism?

    a. Egg Yolk Agar.
    b. Gram stain morphology.
    c. Antibiotic identification discs.
    d. Subculture organism and send to a reference lab for complete identification.

49. An anaerobic culture of a draining mandibular abscess is smeared and cultured. The direct gram stain reveals branching gram positive rods. After several days of anaerobic incubation you would expect the thioglycollate broth to:

    a. have no visible growth.
    b. appear turbid with much gas.
    c. have the "bread crumb" appearance.
    d. produce typical serpentine cording.

50. There is a sudden increase in the recovery of Propionibacterium from blood cultures collected from all floors in the hospital. What is the most likely explanation for this?

a. Perhaps there are more surgical patients being admitted.
b. The blood culture medium in use does not have a low Eh.
c. The blood culture bottles are being incubated at too low of a temperature.
d. Improper decontamination of the patients' arms before blood drawing is occurring.

51. Enterococci are:

a. alpha hemolytic.
b. alpha or beta hemolytic.
c. alpha or gamma hemolytic.
d. alpha, beta or gamma hemolytic.

52. Hemolysis which is described as a zone of partially lysed red cells surrounding a colony and producing greenish or brown discoloration is:

a. alpha.
b. beta.
c. gamma.
d. alpha-prime.

53. All species of Neisseria have the capacity to oxidize:

a. glucose.
b. poly-B-hydroxybutyric acid.
c. para-dimethyl aminobenzaldehyde.
d. tetramethyl-p-phenylenediamine-HCl.

54. Which tests would differentiate between alpha hemolytic streptococci and Streptococcus pneumoniae?

a. catalase and bile solubility.
b. optochin and bile solubility.
c. optochin and bile-esculin hydrolysis.
d. bacitracin and bile-esculin hydrolysis.

55. A catalase test would be useful in distinguishing:

a. Micrococci from streptococci.
b. Staphylococci from Micrococci.
c. Streptococci from pneumococci.
d. alpha streptococci from beta streptococci.

56. Enterococci are:

a. Bile esculin negative and 6.5% NaCl negative.
b. Bile esculin negative and 6.5% NaCl positive.
c. Bile esculin positive and 6.5% NaCl negative.
d. Bile esculin positive and 6.5% NaCl positive.

57. Which organism is NOT considered normal flora of the throat?

    a. Neisseria sicca.
    b. Streptococcus faecalis.
    c. Streptococcus pyogenes.
    d. Streptococcus pneumoniae.

58. Staphylococci that are catalase-positive, slide coagulase-negative, tube coagulase-positive, mannitol-positive, and DNAse-positive are:

    a. Staphylococcus albus.
    b. Staphylococcus aureus.
    c. Staphylococcus epidermidis.
    d. Staphylococcus saprophyticus.

59. Which pair of organisms are most easily differentiated on the basis of gram stain morphology?

    a. Listeria and Corynebacterium.
    b. Micrococcus and Staphylococcus.
    c. Staphylococcus and Corynebacterium.
    d. Alpha hemolytic streptococcus and beta hemolytic streptococcus.

60. Which statement is NOT true concerning Hemophilus hemolyticus?

    a. requires hemin.
    b. requires Factor V only.
    c. grows well on sheep blood agar.
    d. grows well on chocolate agar.

61. To determine if a child is susceptible to scarlet fever, a physician could perform a:

    a. Dick test.
    b. Schick test.
    c. K-L Virulence test.
    d. Schultz-Charlton test.

62. When inoculated to oxidative-fermentative glucose media, Staphylococcus aureus will:

    a. form acid in the sealed tube only.
    b. form acid in the opened tube only.
    c. form acid in both opened and sealed tubes.
    d. not utilize glucose either oxidatively or fermentatively.

63. Which pair of organisms are most easily differentiated by colonial morphology when grown on sheep blood agar in CO_2 atmosphere?

    a. Streptococcus pyogenes and Staphylococcus aureus.
    b. Corynebacterium diptheriae and Erysipelothrix insidiosa.
    c. Listeria monocytogenes and Streptococcus agalactiae.
    d. Streptococcus faecalis and Streptococcus viridans.

64. Division of hemolytic streptococci into serologic groups depends on the occurence of group-specific cellular antigen which is designated as:

    a. M protein.
    b. T protein.
    c. Mucoprotein.
    d. C-carbohydrate.

65. A zone of inhibition of growth around a bacitracin disc indicates that the organism is probably:

    a. Beta hemolytic streptococcus Group A.
    b. Beta hemolytic streptococcus Group B.
    c. Beta hemolytic streptococcus Group D.
    d. Beta hemolytic streptococcus Group G.

66. A gram negative bacilli grows on chocolate agar and does not grow on sheep blood and MacConkey agars. The organism does display "satellitism" with Staphylococcus aureus on sheep blood agar, but does not "satellite" on nutrient agar. From this knowledge, the organism appears to require:

    a. both X and V factors.
    b. neither X nor V factor.
    c. X factor but not V factor.
    d. V factor but not X factor.

67. Fluid, aspirated from the knee of a patient prior to his receiving antibiotic therapy, was cultured on sheep blood agar and chocolate agar. In addition, an anaerobic set up was performed. Aerobically a small, moist, grey colony appeared on the chocolate agar that was oxidase positive. The most likely organism is:

    a. Branhamella catarrhalis.
    b. Neisseria gonorrhoeae.
    c. Hemophilus influenzae.
    d. Corynebacterium hemolyticus.

68. The gram stain from a spinal fluid of a newborn diagnosed as having meningitis shows gram positive cocci in pairs. Which organism is most likely to grow?

    a. Listeria monocytogenes.
    b. Neisseria meningitidis.
    c. Streptococcus agalatiae.
    d. Streptococcus pneumoniae.

69. Blood agar plates, when used for the detection of beta hemolytic streptococci, are incubated in an atmosphere with reduced oxygen tension because:

    a. beta hemolytic streptococci grow best at reduced oxygen tension.
    b. the hemolysin penetrates the agar better in a CO$_2$ environment.
    c. beta hemolytic streptococci produce an oxygen-labile streptolysin.
    d. it inhibits other organisms that might overgrow the beta streptococci.

70. A gram positive cocci demonstrates morphological and colonial characteristics typical of Staphylococcus aureus. The result of a slide test for coagulase using fresh rabbit plasma is negative. The next step would be to:

    a. perform a tube coagulase test.
    b. set up a 6.5% NaCl broth culture.
    c. repeat the slide coagulase test.
    d. report as Staphylococcus epidermidis.

71. A pure culture of a small translucent, beta-hemolytic organism was isolated from blood and wound specimens from the same patient. A gram stain of the blood culture revealed gram positive cocci in long chains. The organism would most likely be:

    a. catalase positive.
    b. coagulase positive.
    c. resistant to penicillin.
    d. susceptible to bacitracin.

72. Gram positive lancet-shaped organisms found on a gram stained smear of an ear culture would most likely grow:

    a. only on chocolate agar.
    b. producing gamma hemolysis.
    c. as colonies flattened with a raised margin and depressed central portion.
    d. as a dry wrinkled colony with bright yellow pigmentation and a narrow band of hemolysis.

73. A C.A.M.P. test is set up on a colony of beta hemolytic streptococcus. Groups A, B and C beta hemolytic streptococci are planted as controls on the same blood agar plate. The next morning Groups A and B both produce an "arrow head hemolysis", while Group C streptococcus and the patient's unknown are negative for this effect. Your next step might be to:

    a. set up a bile esculin test.
    b. perform a catalase test on the unknown.
    c. set up a sodium hippurate hydrolysis test.
    d. report out the unknown as Beta hemolytic Streptococcus Group C.

74. A small gram negative rod occurs in long stands in smears obtained from the genital ulcer of a patient. The ulcer is described as a soft chancre. The physician requests that you culture the specimen for definitive identification. You would most likely:

    a. suggest a VDRL since the organism is too fastidious to grow.
    b. plant the specimen to chocolate agar with VCN added.
    c. heat fresh, clotted human blood for 15 minutes and plant the specimen in the cooled blood.
    d. recommend that a wet mount of the specimen for "clue cells" would be much more diagnostic.

75. A group of children are seen in the clinic and are diagnosed as having a highly communicable conjunctivitis known as "pink eye." The causative agent:

    a. is a gram positive rod-like organism.
    b. rapidly hydrolyzes urea.
    c. is an obligate, intracellular parasite.
    d. satellites around staphylococci on sheep blood agar.

76. Gram negative coffee-bean shaped diplococci are isolated on plain chocolate agar and chocolate agar containing VCN from a spinal fluid specimen. The technologist floods both plates with oxidase reagent and the colonies turn a dark-purple to black in 5 to 10 minutes. CTA sugars are set up. After 48-72 hr. in a normal atmospheric incubator none of the sugar turn acid. The most likely explanation is that:

    a. the organism is a contaminant.
    b. the CTA sugars should have been incubated in a CO_2 incubator.
    c. the organisms were no longer viable.
    d. the technologist should have been looking for the organism's requirements for hemin and NAD.

77. Tumbling motility is a descriptive term associated with an organism that also is:

    a. catalase positive.
    b. gram stain negative.
    c. quellung positive.
    d. alpha hemolytic.

78. A patient suspected on having subacute bacterial endocarditis grows tiny alpha hemolytic colonies from 4 of 6 blood cultures. The organism is catalase negative, optochin negative, 6.5% NaCl broth negative and bile esculin negative. The technologist at this point should:

    a. repeat the biochemical tests.
    b. report out the cultures as Mycoplasma pneumoniae.
    c. report out the cultures as Streptococcus viridans.
    d. set up a Lancefield's grouping.

79. A tube coagulase and a DNase test were set up on colonies of a catalase positive, large yellow, opaque colony. After overnight incubation the tube coagulase was negative but the DNase was positive. This could be explained by the fact that:

    a. a bacteriophage was most likely present that caused this inconsistency.
    b. the correlation between DNase activity and coagulase activity is very poor.
    c. a slide coagulase test is more sensitive since some strains of Staphylococcus aureus may be negative by the tube test.
    d. the coagulase test should have been read in 1-4 hours as false negatives may occur after prolonged incubation.

80. A specimen from a lung abscess was sent to the laboratory for culture. Following 24 hours of incubation, these observations were recorded:

SBA = gram positive cocci
MacC = no growth
Thio = gram positive cocci and gram positive rods

After 48 hours of incubation, the technologist recorded the following:

SBA = gram positive cocci, gram positive rods
MacC = no growth
Thio = gram positive cocci, gram positive rods, gram negative rods
SBA(Anaerobic) = gram positive cocci, gram negative rods

The specimen most likely contained:

a. Clostridium, Staphylococcus, and Klebsiella.
b. Fusobacterium, Bacteroides, and Pneumococcus.
c. Pseudomonas, Corynebacterium, and Streptococcus.
d. Bacteroides, Streptococcus, and Corynebacterium.

81. Members of the genus Brucella are:

a. parasites of animals which may be transmitted to humans.
b. best isolated on Loeffler's serum medium.
c. salt-tolerant organisms that grow best in 7-10% NaCl.
d. positive when tested for toxigenicity with the Elek test.

82. Most spirochetes are best observed:

a. with a Wood's lamp.
b. in stained blood films.
c. using highly enriched media.
d. using dark field microscopy.

83. The isolation of cell-wall defective bacteria from a blood culture could be attempted by:

a. adding 10% sucrose to the broth.
b. adding cysteine to the broth.
c. incubating the media for 21 days.
d. incubating the media at room temperature.

84. An organism formerly classified as a Vibrio that is frequently isolated from cases of diarrhea and that requires selective media in reduced oxygen tension is:

a. Treponema pinta.
b. Campylobacter fetus.
c. Chlamydia trachomatis.
d. Leptospira interrogans.

85. Diagnosis of Rat-Bite fever should be based upon demonstration of Spirillum minus by any of the following means EXCEPT:

a. cultivation and recovery of the organism on artificial media.
b. inoculation of white mice and guinea pigs with the patient's blood or exudate.
c. examination of blood and exudate by dark-field examination.
d. immobilization test using a mixture of patient's serum with the blood of a mouse containing spirilla.

86. A patient has been on I.V. therapy for 10 days and develops sepsis. Three successive blood cultures grow a gram positive, fat bacillus that appears on blood agar incubated aerobically as large, flat, dull colonies with a typical ground-glass appearance. The organism is most likely:

a. Listeria sp.
b. Bacillus sp.
c. Corynebacterium sp.
d. Erysipelothrix sp.

87. A patient had been out hunting rabbits and is now suspected of having tularemia. What ingredients should be present in the medium in order to isolate the causative agent?

a. potato-glycerol-blood.
b. cystine-blood-glucose.
c. hemin and NAD.
d. potassium tellurite and blood.

88. A physician suspects a case of Vibrio cholerae, however, the laboratory does not have any TCBS agar available. You could substitute:

a. McBride's medium.
b. McClung-Toabe agar.
c. alkaline peptone water.
d. peptone water with 7-10% NaCl.

89. A cattle farmer develops a cutaneous lesion and a specimen is sent to the laboratory for gram stain and culture. On gram stain, the specimen reveals many long, fat gram positive bacilli that line up end-on-end and have a bamboo-like appearance. The technologist should:

a. plant the specimen aerobically and anaerobically.
b. send the specimen to a public health laboratory because the organism could be extremely hazardous to work with in a routine clinical laboratory setting.
c. send the specimen to a veternary laboratory for animal inoculation.
d. culture the specimen in Fletcher's media.

90. A male patient is suspected of having gonorrhoea, however, both smear and culture of his discharge are negative for N. gonorrhoeae. You might suggest:

    a. repeating the culture and smear with a fresher specimen.
    b. performing a darkfield for spirochetes.
    c. a specimen be cultured for Ureaplasma.
    d. increasing the agar content of the media to isolate the more fastidious gonococci.

91. The specimen of choice for a patient with possible miliary tuberculosis is:

    a. CSF.
    b. urine.
    c. blood.
    d. sputum.

92. The characteristic that separates Runyoun Group IV from the other Mycobacteria is:

    a. growth rate.
    b. catalase production.
    c. niacin accumulation.
    d. pigment production after exposure to light.

93. Isoniazid resistance of an identified culture of M. tuberculosis may be suspected when:

    a. the tellurite reaction is negative.
    b. the arylsulfatase test is positive.
    c. the catalase drop test is positive.
    d. MacConkey agar supports the growth of this organism.

94. An acid-fast organism has been isolated from the skin lesion of a deep-sea fisherman. A likely organism is:

    a. M. bovis.
    b. M. marinum.
    c. M. scrofulaceum.
    d. M. tuberculosis.

95. All of the following are culture characteristics of Mycobacterium tuberculosis EXCEPT:

    a. produces dry, cheesy, buff colored colonies.
    b. forms serpentine cords on the surface of media.
    c. requires simple, selective synthetic media for growth.
    d. may grow within 7 to 10 days on Middlebrook agar medium.

96. In the AFB concentration procedure, N-acetyl-L-cysteine (NALC) is:

a. the decontaminating agent.
b. added to the sediment to neutralize the material.
c. a mucolytic agent without antibacterial activity.
d. toxic to the acid-fast bacilli, therefore timing is critical.

97. After staining a batch of smears for acid-fast bacilli using auramine-rhodamine, it was discovered that the control smear did not give a 4+ reaction. This suggests:

a. the slides were overdecolorized.
b. the stain was not properly filtered.
c. the UV bulb probably has over 400 hours of use.
d. the stain was left on the slides for more than 30 minutes.

98. Within two hours after inoculating specimens to Lowenstein-Jensen, the slants appear "bright blue" in color. This suggests:

a. albumin was not added prior to inoculation.
b. the supernatant was not removed before inoculation.
c. a normal reaction after inoculating; continue incubation.
d. the inocula were too alkaline and the specimens should be rediluted or reprocessed.

99. A non-photochromogen is isolated from the sputum of a veterinarian who specializes in farm animals. The niacin test is positive. Because of his occupation you are asked to differentiate this organism from M. bovis. Which test would you recommended?

a. growth on Petragoni medium.
b. arylsulfatase test.
c. check the rate of growth record.
d. tween hydrolysis in 7H10 medium.

100. Two smears of a patient's sputum are stained for acid-fast bacilli, one with the Kinyoun Acid Fast procedure and the other using the Truant-fluorachrome method. The fluorachrome procedure shows many acid-fast bacilli, however the Kinyoun acid-fast smear is negative. Which statement best explains what might have occurred?

a. The Kinyoun stain was overdecolorized.
b. This could result as a matter of sampling technique.
c. The fluorachrome procedure has a higher specificity for acid-fast organisms.
d. The fluorachrome stain stains dead AFB cells as well as viable cells and the Kinyoun stains only viable cells.

101. A patient is unable to supply the laboratory with an adequate sputum specimen. Which specimen collection procedure should be next suggested?

a. lung biopsy.
b. bronchial washing.
c. nebulized sputum.
d. nasopharyngeal swab.

102. The most acceptable method for checking the pH of solid media is to determine the pH:

a. before autoclaving.
b. prior to pouring the plates.
c. on the finished, cooled product.
d. during each step of the media-making process.

103. Motility media generally have an agar content of:

a. less than 0.4%
b. 0.3 -0.7%
c. 0.8 -1.4%
d. 1.0 -1.4%

104. The indicator generally used to monitor anaerobic conditions during incubation is:

a. neutral red.
b. crystal violet.
c. methylene blue.
d. bromthymol blue.

105. The staining reagents required to prepare a gram stain properly are:

a. gentian violet, lugol's iodine, safranin.
b. gentian violet, copper sulfate, carbol fuschin.
c. crystal violet, potassium hydroxide, carbol fuschin.
d. crystal violet, potassium iodine, safranin.

106. To obtain a pure culture of a bacterium, a microbiologist could do any of the following EXCEPT:

a. make a series of dilutions on agar plates.
b. streak to a solid nutrient medium surface.
c. inoculate a broth tube with a light inoculum.
d. use a medium that is inhibitory to other organisms.

107. If a delay is unavoidable in processing a spinal fluid specimen for culture, the CSF should be kept at:

a. 2-4°C.
b. 20-25°C.
c. 35-37°C.
d. 42-44°C.

108. Buffered single-substrate media for the identification of non-fermentative gram negative bacilli contain a(n):

a. acid, a pH buffer and a carbohydrate.
b. amine, a pH indicator and a nitrogen source.
c. alcohol, a pH buffer and peptones.
d. pH indicator, a phosphate buffer and a carbohydrate.

109. A sheep blood agar and MacConkey agar were each inoculated with 0.001 ml of urine. After overnight incubation 100 colonies of a gram negative rod were observed on both media. How many colonies/ml were cultured from the urine?

a. 1,000
b. 10,000
c. 100,000
d. 1,000,000

110. Leukocytes, complement and certain aminoglycosides are inactivated in a blood culture that:

a. has been properly diluted.
b. contains penicillinase.
c. contains sodium polyanetholsulfonate.
d. is incubated in an atmosphere of 10% CO_2.

111. The catalyst in the Gas Pak anaerobic jar needs to be:

a. changed when it no longer turns white.
b. stored overnight in an airtight container when not in use.
c. reactivated by heating in a 160°C oven for two hours about every two days of use.
d. kept moist by the use of wet toweling in the bottle of the jar.

112. A motile nonfermentative bacillus is observed in an alcoholic stain of rosaline. The structure observed is a ___________ and the stain is a modification of ______________.

a. flagellum; Loeffler.
b. flagellum; Leifson.
c. capsule; Albert.
d. capsule; Hank's.

113. Select the one best combination of media that could be used for the primary isolation and plating of a synovial fluid:

a. sheep blood agar, chocolate agar, phenylethylalcohol agar.
b. sheep blood agar, Thayer-Martin agar, chocolate agar.
c. sheep blood agar, chocolate agar, brain heart infusion broth.
d. sheep blood agar, Thayer-Martin agar, columbia CNA agar.

114. The laboratory ran out of MacConkey and EMB agar plates. Which medium would be the best choice for a substitution?

a. Sheep blood agar.
b. Hektoen enteric agar.
c. Triple sugar iron agar.
d. Desoxycholate citrate agar.

115. A patient's urine culture yielded greater than 100,000 col/ml of Staphylococcus epidermidis, and 60,000 col/ml of Escherichia coli. To make sure this is an infection involving two organisms and not contamination you might suggest:

   a. a catheterized specimen and repeat the culture.
   b. a suprapubic aspiration and repeat the culture.
   c. a clean catch midstream specimen and repeat the culture.
   d. nothing. It is not necessary to do any more, only when three or more organisms are present is contamination suspected.

116. The anaerobic glove box uses the entire cylinder of gas which maintains the anaerobic conditions. The next cylinder of gas is not expected for four hours. What is the recommended procedure to take?

   a. Reinoculate all cultures when the gas is connected.
   b. Remove all cultures and place them in anaerobic gas pak jars.
   c. Leave the system closed until the new gas cylinder is connected.
   d. Place 3 to 4 hydrogen-generating packets from a gas pak system in the chamber.

117. A gram positive diplococci is found on a gram stained smear of a vaginal culture. An identical specimen is sent for repeat smear and gram stain the same day. This smear result was gram negative diplococci. The next step would be to:

   a. request a new specimen.
   b. change all stains and reagents.
   c. repeat the gram stain a third time.
   d. decolorize and restain both smears.

118. Gram positive bacilli are observed from a smear made of the colonies from a MacConkey agar plate. The most likely explanation is:

   a. the organisms were over-decolorized.
   b. MacConkey's agar inhibits only gram positive cocci.
   c. the organisms are contaminants from the staining bottle.
   d. the mordant may have remained on the specimen too long.

119. The sulfonamides interfere with the bacterium's:

   a. cytochrome system.
   b. synthesis of nucleic acid.
   c. cell membrane development.
   d. synthesis of p-aminobenzoic acid.

120. An antibiotic effective against penicillinase-producing organisms is:

   a. ampicillin.
   b. penicillin G.
   c. carbenicillin.
   d. methicillin.

121. The recommended depth of agar in the Kirby-Bauer disc diffusion method of susceptibility testing is:

a. 1-3 mm.
b. 4-6 mm.
c. 7-8 mm.
d. 9-10 mm.

122. Serum bactericidal tests utilize:

a. the bacterial strain isolated from the patient.
b. a reference strain of bacteria.
c. a highly resistant reference strain of bacteria.
d. a highly susceptible reference strain of bacteria.

123. The results of a disc diffusion sensitivity test may result in the organism appearing more resistant than it really is if:

a. the medium has too low of a pH.
b. the medium contains too high salt concentration.
c. there is too little agar in the plate.
d. there are too many organisms in the inoculum.

124. The streptococci most likely to have a high minimum bactericidal concentration with penicillin belong to the:

a. Enterococci group.
b. Group A streptococci.
c. Group G streptococci.
d. viridans group of streptococci.

125. An antibiotic susceptibility test is reported "resistant" if:

a. there is no zone of inhibition seen.
b. the microorganism does not grow up to the disc.
c. there is a zone of growth inhibition around the disc.
d. the zone of inhibition is less than that indicated for the particular antibiotic.

126. Antibiotic discs should be stored in a refrigerator to prevent deterioration due to:

a. light.
b. humidity.
c. evaporation.
d. contamination.

127. Which organism should NOT be tested for susceptibility to antibiotics by using the Kirby-Bauer disc method?

a. Klebsiella oxytoca.
b. Staphylococcus epidermidis.
c. Neisseria meningitidis.
d. Pseudomonas maltophilia.

128. Susceptibility testing should be performed:

   a. routinely on all clinically significant isolates.
   b. on isolates that are known to be highly susceptible.
   c. only on specimens from normally sterile body fluids or tissues.
   d. when the clinical picture warrants the use of secondary drugs of choice.

129. Direct susceptibility testing may be considered appropriate from which body site?

   a. blood.
   b. sputum.
   c. urine.
   d. wound.

130. Some organisms become resistant to antibiotics because:

   a. the bacteria can convert the antibiotic to a nutrient.
   b. the cell wall becomes impermeable to the antibiotic.
   c. susceptible strains emerge.
   d. the antibiotic is easily denatured.

131. A laboratory needs to place a number of discs on each susceptibility plate. To prevent overlapping of the zones of inhibition, the discs should be placed no closer than:

   a. 12 mm.
   b. 14 mm.
   c. 20 mm.
   d. 24 mm.

132. A student technologist was having difficulty reading the zone of inhibition around the sulfonamide disc. The technologist correctly recommended that:

   a. slight growth be disregarded.
   b. slight growth be considered indicative of resistance.
   c. moderate growth be disregarded.
   d. any growth within the zone be considered indicative of resistance.

133. A physician requested an early reading of a Kirby-Bauer disc susceptibility test to aid in the management of a seriously ill patient. A reading after only 8 hours would be considered:

   a. always inaccurate; therefore not done.
   b. only about 50% accurate; therefore not done.
   c. accurate most of the time; however, reincubated and read in 18-24 hours.
   d. accurate 100% of the time if sufficient growth; therefore, the plate need not be incubated further.

134. The measurement of beta-lactam antimicrobials in the presence of aminoglycosides may be inactivated by all of the following EXCEPT:

a. assaying at pH 5.5.
b. assaying in the presence of high concentrations of calcium.
c. adding penicillinase.
d. adding sodium polyanethol sulfonate.

135. The "peak" serum level for bactericidal testing is obtained:

a. one hour after intravenous infusion or immediately after intramuscular injection.
b. one hour after intramuscular injection or immediately after intravenous infusion.
c. immediately after either intravenous infusion or intramuscular injection.
d. immediately prior to intravenous infusion or intramusular injection.

136. Sugars, serum and tissue extracts are best sterilized by:

a. dry heat.
b. filtration.
c. special chemicals.
d. heat with pressure.

137. The prevalence of a disease refers to:

a. the ratio of the number of new cases to that of old cases.
b. the ratio of the number of clinical cases to that of subclinical cases.
c. the number of cases in a specific population at a given time.
d. the number of cases in a specific population over a period of time.

138. The efficiency of an autoclave should be checked at regular intervals by monitoring sterilization with a biological indicator. The recommended organism to use is:

a. Bacillus subtilis.
b. Bacillus stearothermophilus.
c. Clostridium tetani.
d. Clostridium perfringens.

139. The working surface areas of the laboratory should be decontaminated:

a. after each spill of viable materials.
b. at least once a day and after spills with a disinfectant.
c. at least twice a day with green soap.
d. as often as needed with a sterilizing solution.

140. The active proteins of a bacterial cell are denatured by all of the following chemical agents EXCEPT:

a. acids.
b. acetone.
c. alkalis.
d. basic dyes.

141. Pseudomonas aeruginosa was cultured in large numbers from a previously culture-negative burn surface of a patient. This finding suggests:

a. that the organism was highly resistant.
b. that the patient may have a hospital-acquired infection.
c. inadequate or poorly-managed nursing care.
d. that the organism can grow anaerobically.

142. The degree of correspondence between an obtained value and a true value is termed:

a. accuracy.
b. precision.
c. reliability.
d. reproducibility.

143. Each batch of media that is made should be tested for sterility by:

a. using spore strips in the autoclave.
b. using stock cultures with known biochemical reactions.
c. examining uninoculated media after incubation.
d. visual inspection after the media has cooled down.

144. Calibrated inoculating loops that are rough or irregular should be:

a. reshaped.
b. replaced.
c. recalibrated.
d. sent to the manufacturer for repair.

145. Gas cylinders in the laboratory:

a. should be chained to a stationary object only when full.
b. should be individually chained to a stationary object at all times.
c. can be chained together providing they are tightly wrapped.
d. should be left unchained for better mobility.

146. The animal research lab has a dead infected animal to be discarded. You should recommend:

a. irradiation.
b. incineration.
c. ethylene oxide gas.
d. autoclaving at 15 PSI, 121^{o}C for 60 minutes.

147. The chief of urology asks the laboratory to perform routine environmental sampling of the urology ward. The correct evaluation of such sampling is that it is:

a. necessary because of its educational value.
b. the best way to monitor housekeeping in this critical area.
c. necessary because of its direct relationship with nosocomial infections.
d. unnecessary and economically unjustifiable, providing data that is impossible to interpret.

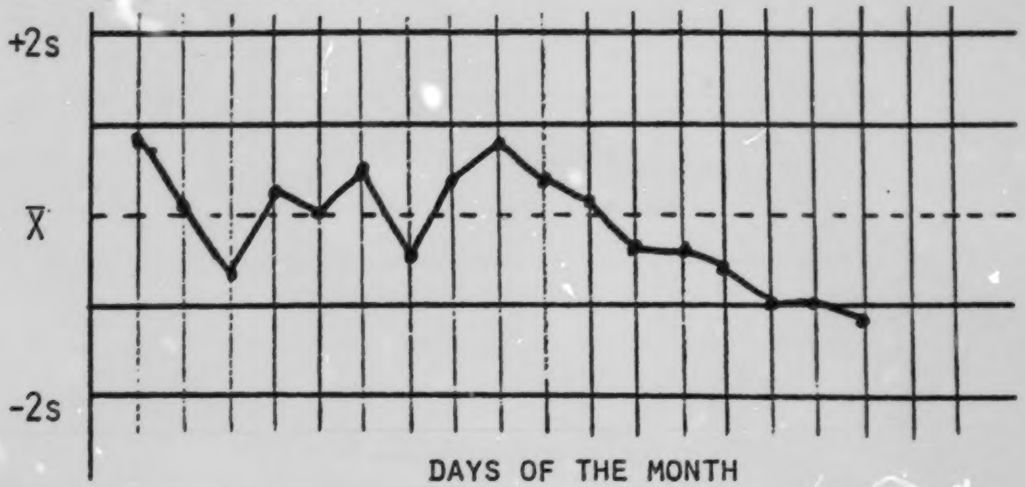
148. "Blind unknowns":

a. need not be performed if the laboratory subscribes to proficiency testing as disseminated from CAP or the state laboratory.
b. are a more valuable internal quality control than proficiency testing.
c. should be discouraged since such fictitious reporting leads to mistrust of the employee toward the supervisor.
d. are the best way to quality control gram stain interpretations.

149. The laboratory is requested to perform a gram stain of material from an anus or rectum for gonococci. The technologist should:

a. perform the gram stain as directed.
b. cross gram smear request off the form and culture instead.
c. stamp "Specimen unsatisfactory. Please submit urethral swab."
d. return request form to the floor immediately for confirmation.

150. A laboratory routinely plots the zone sizes obtained when **they** quality control their disc diffusion method of suspectibility testing. The chart below represents the daily reading of the zone of inhibition of Staphylococcus aureus around ampicillin. The chart suggests that the ampicillin discs are:



a. within 2 S.D. and therefore in control.
b. out of control; it could be caused by deterioration of the barium sulfate standard.
c. out of control; it could be caused by decreased disc potency.
d. still within control but must be watched if they fall below 2 S.D.

151. Deuteromycotina organisms are referred to as Fungi Imperfecti because they:

   a. lack true roots.
   b. are aerobic organisms.
   c. are aquatic organisms.
   d. have no known sexual reproductive stage.

152. A sputum specimen is received in the laboratory. A request for a fungal smear is made. What is the best method to use for performing the direct smear?

   a. gram stain.
   b. india ink preparation.
   c. potassium hydroxide mount.
   d. lactophenol cotton blue stain.

153. A medium used for routine isolation of fungus is:

   a. Mycosel agar.
   b. Cornmeal agar.
   c. Potato dextrose agar.
   d. Nickerson's BIGGY agar.

154. A hyaline mold usually considered to be a saprophyte that produces flask-shaped conidiophores terminating into a branching brushlike structure and produces colonies that are green to blue in color is:

   a. Aspergillus.
   b. Penicillium.
   c. Paecilomyces.
   d. Scopulariopsis.

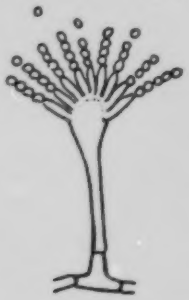
155. The term used for brownish colored hyphae as found in Cladosporium type fungi is:

   a. rusty.
   b. geophilic.
   c. melanogenic.
   d. dematiaceous.

156. A deep red diffusely pigmented fungi is recovered from a superficial lesion. The urease reaction is negative at 7 days. Tear-shaped microaleuriospores are observed on microscopic examination. The hair perforation test is negative. The organism can be identified as:

   a. Microsporum canis.
   b. Trichophyton rubrum.
   c. Trichophyton violaceum.
   d. Trichophyton mentagrophytes.

157. A rapidly growing fungus produces a flat, white colony that quickly turns bluw-green. Microscopic examination reveals the picture below. The isolate is most likely:

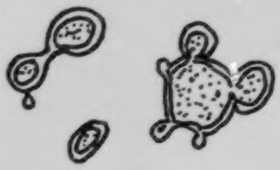


a. Aspergillus fumigatus.
b. Aspergillus niger.
c. Paecilomyces sp.
d. Penicillium sp.

158. A fungus is observed on Sabouraud's dextrose agar at 25°C. The organism grows slowly in about four weeks and develops aerial, white, cottony mycelia. When cultured at 37°C a yeast colony appears that demonstrates thick-walled, broad base buds. The organism is most likely:

a. Coccidioides immitis.
b. Histoplasma capsulatum.
c. Blastomyces dermatitidis.
d. Paracoccidioides brasiliensis.

159. A gastrointestinal lesion is examined with a KOH preparation. The patient is a recent immigrant from Columbia. The microscopic examination reveals the picture below. Based on the illustration, the etiological agent is most likely:



a. Histoplasma capsulatum.
b. Cryptococcus neoformans.
c. Petriellidium boydii.
d. Paracoccidioides brasiliensis.

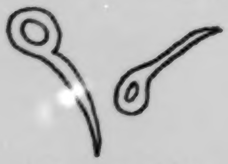
160. A black fungus is isolated on Sabouraud's dextrose agar from the foot of a patient with mycetoma. Septate hyphae with short flask-shaped conidiophores bearing clusters of oval conidia are observed on cornmeal-Tween 80 agar. The organism is most likely:

a. Nigrospora sp.
b. Phialophora sp.
c. Cladosporium sp.
d. Aureobasidium sp.

161. A methenamine silver stain is performed on a bronchial washing of a patient receiving immunosuppressive therapy. Multiple septated hyphal strands 2.5-4.5 um in diameter that show repeating dichotomous branching at 45° angles are observed. The etiological agent is most likely:

a. Mucor sp.
b. Aspergillus sp.
c. Candida sp. with pseudohyphae.
d. Histoplasma capsulatum.

162. A germ tube test is set up using pooled human sera. The tube is incubated for 4 hours at 37°C. The technologist forgets to include controls with the new lot of pooled human sera. The following observation is observed as pictured below. How should the results be interpreted?



a. report out as germ tube positive for C. albicans.
b. report out as germ tube negative for C. albicans.
c. repeat the test because it is inconclusive without the use of controls.
d. repeat the test using controls and adjust the incubation time to 3 hours.

163. Microsporum sp. can be differentiated from Trichophyton sp. because:

a. Microsporum produces large spiny thick-walled macroconidia.
b. Microsporum produces club shaped macroconidia.
c. Trichophyton produces spiny thick-walled macroconidia.
d. Trichophyton do not produce microconidia.

164. A superficial crust lesion is removed from the foot of a male who had resided in the tropics for 10 years. Upon direct examination with KOH, a long brown branching hyphae, 2-5 microns in width is observed. The mycotic infection is most likely a(n):

a. Aspergillosis.
b. Chromomycosis.
c. Sporotrichosis.
d. Dermatophytosis.

165. A yeast consisting of only blastoconidia is observed on cornmeal agar with Tween 80. The organism is urease negative, nitrate negative, germ tube negative and ferments only dextrose and trehalose. The organism can be identified as:

a. Candida krusei.
b. Torulopsis glabrata.
c. Cryptococcus albidus.
d. Saccharomyces cerevisiae.

166. A visitor from Indiana is presented to the physician with a primary granulomatous lesion of the lung. A biospy reveals phagocytic cells containing small oval cells surrounded by halo cell walls when stained with Giemsa. The organism most likely to isolated at room temperature will develop as:

a. cigar-shaped yeast cells.
b. oval microconidia borne laterally on branching hyphae.
c. a perithecia containing numerous ascospores.
d. tuberculate macroconidia with many sessile microconidia.

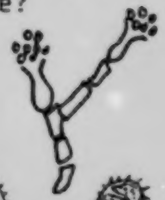
167. A fungus culture grows rapidly but produces sterile mycelia. To attempt to induce spore production, a technologist should:

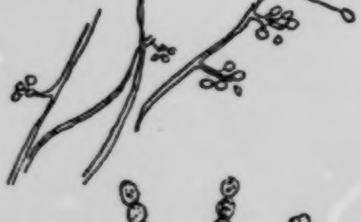
a. incubate the specimen longer.
b. incubate the specimen anaerobically.
c. subculture the specimen to potato dextrose agar.
d. subculture the specimen to BHI blood agar with cycloheximide.

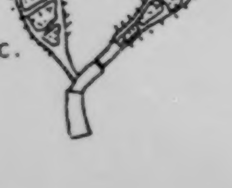
168. A patient is suspected of having Crytococcal meningitis. The CSF is centrifuged and examinated for yeast with India ink. Many WBC are present, however, no yeast forms are observed. A most likely explanation might be:

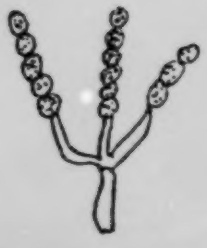
a. the patient was misdiagnosed.
b. the specimen should have been gram stained as well.
c. some of the WBCs many have actually been the yeast cells.
d. centrifugation may have destroyed the more fragile yeast cells.

169. A horticulture student stuck her finger on a thorn and a lesion developed. A culture reveals a tan colony on Sabouraud dextrose agar that on further incubation turns black. Direct examination of the exudate shows cigar-shaped yeast like forms. Which of the following illustrations would most likely represent the mycelial phase?

a.


b.


c.


d.


170. A cornmeal-Tween 80 slide culture reveals a yeast colony that forms hyphae and arthroconidia. What additional structure(s) should be noted in order to identify the genus of this yeast?

a. blastospores.
b. chlamydospores.
c. thallospores.
d. ascospores.

171. The number of nuclei that would distinguish cysts of Entamoeba coli from Entamoeba histolytica adequately is:

a. 2.
b. 3.
c. 4.
d. 5.

172. The karyosome of Entamoeba histolytica can be described as:

a. basket-like.
b. large and fragmented.
c. invisible on trichrome stain.
d. relatively small and delicate.

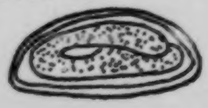
173. The flagellate that demonstrates two large sucking discs in the trophozoite stage is:

a. Giardia lamblia.
b. Balantidium coli.
c. Trypanosoma cruzi.
d. Chilomastix mesnili.

174. The only Plasmodium species that can be identified by its gametocytes alone is:

a. ovale.
b. vivax.
c. malariae.
d. falciparum.

175. The roundworm pictured below is:



a. Trichuris trichiura.
b. Ascaris lumbricoides.
c. Paragonimus westermani.
d. Enterobius vermicularis.

176. A person who may ingest food contaminated with feces may be subject to infection with all of the following EXCEPT:

a. Balantidium coli.
b. Hymenolepsis nana.
c. Necator americanus.
d. Entamoeba histolytica.

177. The asexual stage of the Plasmodia is found in:

a. man.
b. fleas.
c. ticks.
d. mosquitoes.

178. An organism easily visualized using the 10X objective of a microscope can be described as having two nuclei, one large, bean-shaped nucleus and a small, round nucleus located in the groove of the larger one. The organism is actively motile in a circular fashion. The organism is most likely:

a. Chilomastix mesnili.
b. Balantidium coli.
c. Trichomonas hominis.
d. Trichomonas tenax.

179. The scolex of a tapeworm is recovered after treatment of an infection. Four suckers devoid of hooklets are seen on the scolex. The description characterizes:

a. Taenia solium.
b. Taenia saginata.
c. Hymenolepsis nana.
d. Hymenolepsis diminuta.

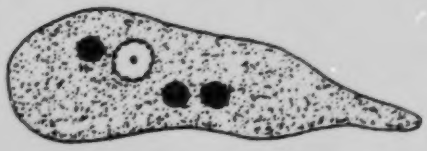
180. Mature, gravid proglottids were found in the feces of a child. On microscopic examination of the proglottid section, ova encased in groups were seen. This is characteristic of:

a. Dipylidium caninum.
b. Echinococcus granulosis.
c. Diphyllobothrium latum.
d. Hymenolepsis diminuta.

181. A large, spherical cyst with 6 nuclei that has coarsely granular, unevenly arranged peripheral chromatin is most likely:

a. Entamoeba coli.
b. Endolimax nana.
c. Entamoeba hartmanni.
d. Entamoeba histolytica.

182. A trichrome stain reveals the protozoan pictured below. It exhibits 1 nucleus that has a small, compact karyosome centrally located. The cytoplasm is finely granular and contains ingested red blood cells. The organism can be identified as:



a. Entamoeba coli.
b. Entamoeba polecki.
c. Entamoeba gingivalis.
d. Entamoeba histolytica

183. The peripheral smear of a person with malaria demonstrates a moderate amount of ring forms in large to oval red blood cells. Schuffner's dots are present in many of the red blood cells and occasional mature schizonts with 16-20 merozoites are seen. The plasmodium can be identified as:

a. falciparum.
b. malariae.
c. ovale.
d. vivax.

184. The ova of Ascaris lumbricoides can be described as:

a. large, oval and operculated.
b. large, thick mammilated shelled.
c. thin walled with one side flattened.
d. thick walled with a prominant lateral spike.

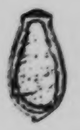
185. The purpose of performing a formalin-ether concentration procedure includes all of the following EXCEPT:

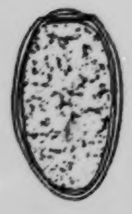
a. to kill the organism and to preserve the specimen after concentration.
b. to detect motile trophozoites that might otherwise be "hidden" in fecal debris.
c. to allow the recovery of protozoa, eggs and larvae by extracting debris in the ether layer.
d. to allow the detection of a small number of organisms that might be missed using only the direct mount.

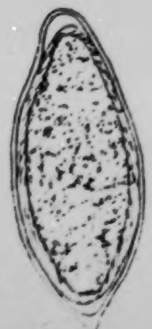
186. The flotation technique for concentration of ova and parasites:

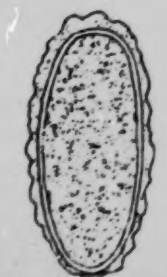
a. cannot be used on formed stools.
b. recovers operculated ova better than the sedimentation method.
c. employs a high specific gravity of zinc sulfate.
d. distorts protozoan cysts more than the sedimentation method.

187. The diagnostic stage of the Chinese liver fluke would appear in the stool as:

a. 

b. 

c. 

d. 

188. The cytoplasm of properly fixed and stained cysts and trophozoites is blue-green with purple tinge when stained with:

a. giemsa.
b. trichrome.
c. iron hematoxylin.
d. Chlorozol black E.

189. The absolute length size of an organism seen on an ocular micrometer depends on the:

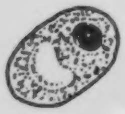
a. eyepieces.
b. magnification.
c. focal adjustment.
d. wavelength of light.

190. A 26-year old man was admitted to the emergency room with symptoms of meningitis. Bacterial cultures of the spinal fluid were negative. What fact would provide important information toward a diagnosis of Naegleria infection? The patient:

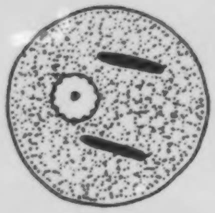
a. is a second grade teacher.
b. was in VietNam a year ago.
c. usually walked barefooted.
d. went swimming in a lake.

191. An adult patient presented with symptoms of biliary disease. Microscopic examination of the biliary drainage revealed a number of flagellated, binucleated organisms. The cyst stage of this organism would appear as:

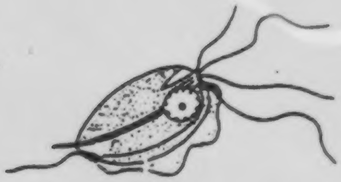
a.



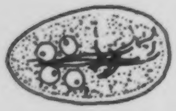
b.



c.



d.



192. A patient, having left the tropics of Africa 10 days prior to early symptoms which included headache, nausea and malaise, suffered a sudden attack of a chill and rise in temperature which was sustained over many hours. This was followed by a brief sweating period. This clinical course suggests an infection due to:

a. filaria.
b. malaria.
c. schistosomes.
d. trypanosomes.

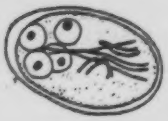
193. On a direct wet preparation of a diarrhetic stool an organism is identified as an amoeba. The next day a sample of the specimen is prepared and stained with a permanent stain such as trichrome, however, no amoebic organisms are seen. The most likely explanation is that:

   a. the organism was mistakenly identified on the direct wet preparation.
   b. amoebic structures do not always stain well with trichrome.
   c. the specimen contained an interfering substance to the staining procedure.
   d. the specimen was not fixed soon enough after receipt and the apparent trophozoites seen did not survive.

194. A splintered chromatoidal body or bar would be seen in a cyst whose nucleus contains:

   a. a large blot-like karyosome.
   b. unevenly distributed chromatin material.
   c. a small, centrally-located karyosome.
   d. no peripheral chromatin.

195. Numerous cysts as pictured below were seen from a stool specimen. Which of the statements below is correct concerning this organism?



   a. The trophozoite has an undulating membrane.
   b. The trophozoite has a large, single nucleus located centrally.
   c. The trophozoite is said to have a falling leaf movement.
   d. The trophozoite has two pair of flagella.

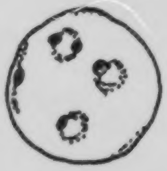
196. A stool specimen has numerous amoebic trophozoites seen in moving in a unidirectional, progressive fashion when observed in direct wet mount. The specimen is most likely:

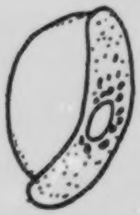
   a. semiformed.
   b. freshly passed and liquidy.
   c. preserved adequately with PVA.
   d. stained with D'Antoni's iodine to observe such movement.

197. Nursing service calls and asks what type of specimen they should send for a Toxoplasmosis request. You would most likely suggest:

   a. a fresh stool specimen.
   b. a clean voided urine specimen.
   c. a peripheral bl[illegible]mear.
   d. an acute and convalescent serum sample.

198. The two structures pictured below were seen in a thin blood film stained with giemsa. These structures indicate an infection with:





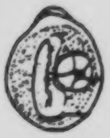
a. Plasmodium vivax.
b. Plasmodium falciparum.
c. a mixture of two plasmodia species.
d. Plasmodium vivax, however stucture II is an artifact.

199. An insect is sent to the laboratory for identification. It can be described as having a head, thorax and abdomen as separate segments. There is one pair of antennae on the head. The thorax contains three pairs of legs and is wingless. The insect is dorsoventrally flat and can be identified as a:

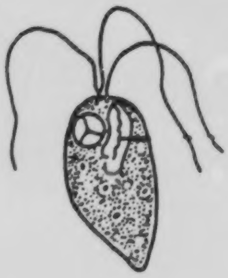
a. mite.
b. tick.
c. louse.
d. bed bug.

200. Identify the structures below:

I



II



a. I is Chilomastix mesnili; II is Trichomonas hominis.
b. I is Trichomonas tenax; II is Chilomastix mesnili.
c. I and II are Chilomastix mesnili.
d. I and II are Trichomonas sp.

C3

MLT-A

Question Number	Correct Answer	Crit. Ref.				MPI	Grid Reference	Taxonomy Level
		a	b	c	d			
Enteric & Nonfastidious Gram Negative Rods(35)								
1	d	0	0	0	X	1.00	IIA1	Recall
2	d	1	0	0	X	.67	IIA2	Recall
3	b	0	X	0	0	1.00	IIB1	Recall
4	a	X	0	2	0	.50	IIB1	Recall
5	c	0	0	X	0	1.00	IIB1	Recall
6	a	X	0	1	0	.67	IIB1	Recall
7	c	0	0	X	2	.50	IIB1	Recall
8	d	0	0	0	X	1.00	IIB3	Recall
9	c	0	0	X	0	1.00	IIB3	Recall
10	b	0	X	0	0	1.00	IIB3	Recall
11	b	0	X	0	0	1.00	IIB3	Recall
12	a	X	0	0	0	1.00	IIC1	Recall
13	b	0	X	0	0	1.00	IIC1	Recall
14	b	1	X	0	0	.67	IIC1	Recall
15	b	1	X	0	1	.50	IIC1	Recall
16	a	X	0	0	0	1.00	IIC1	Recall
17	d	1	1	1	X	.40	IIC1	Recall
18	a	X	1	0	0	.67	IIC2	Recall
19	b	0	X	0	0	1.00	IID1	Recall
20	c	0	0	X	0	1.00	IIA1	Interpret.
21	d	1	0	1	X	.50	IIA3	Interpret.
22	c	0	0	X	1	.67	IIB1	Interpret.
23	a	X	0	0	0	1.00	IIB1	Interpret.
24	d	1	0	0	X	.67	IIB1	Interpret.
25	a	X	0	0	0	1.00	IIB3	Interpret.
26	c	0	1	X	0	.67	IIB3	Interpret.
27	d	0	1	0	X	.67	IIB3	Interpret.
28	c	0	0	X	0	1.00	IIC1	Interpret.
29	a	X	0	0	2	.50	IIC1	Interpret.
30	b	0	X	0	0	1.00	IIC1	Interpret.
31	a	X	1	0	0	.67	IIC2	Interpret.
32	b	0	X	2	0	.50	IIB1	Prob. Solv.
33	c	0	0	X	1	.67	IIB3	Prob. Solv.
34	d	0	0	1	X	.67	IIC1	Prob. Solv.
35	b	1	X	1	0	.50	IIC1	Prob. Solv.
Anaerobes (15)								
36	b	2	X	0	0	.50	IA1	Recall
37	d	1	1	1	X	.40	IA2	Recall
38	d	2	2	0	X	.33	IB1	Recall
39	d	2	2	0	X	.33	IB2	Recall
40	b	0	X	2	0	.50	IB3	Recall
41	a	X	0	0	0	1.00	IC1	Recall
42	b	0	X	0	2	.50	ID2	Recall
43	d	0	0	0	X	1.00	ID3	Recall

MLT-A

Question Number	Correct Answer	Crit. Ref.				MPI	Grid Reference	Taxonomy Level
		a	b	c	d			
44	a	X	1	0	0	.67	IA1	Interpret.
45	d	0	1	1	X	.50	IA2	Interpret.
46	c	2	1	X	0	.40	IB1	Interpret.
47	b	1	X	0	0	.67	IB3	Interpret.
48	d	1	0	0	X	.67	IC1	Interpret.
49	c	0	0	X	0	1.00	ID1	Interpret.
50	d	1	1	1	X	.40	IA1	Prob. Solv.
Staph., Strep., Neis., Hemophilus (40)								
51	d	0	0	0	X	1.00	1,obj.1	Recall
52	b	0	X	0	1	.67	1,obj.1	Recall
53	a	X	0	0	0	1.00	1,obj.1	Recall
54	b	0	X	0	0	1.00	1,obj.2	Recall
55	b	0	X	0	0	1.00	1,obj.3	Recall
56	a	X	0	0	1	.67	1,obj.3	Recall
57	b	0	X	1	1	.50	1,obj.4	Recall
58	d	0	0	1	X	.67	1,obj.4	Recall
59	d	0	0	0	X	1.00	1,obj.4	Recall
60	d	1	0	0	X	.67	1,obj.5	Recall
61	b	0	X	1	0	.67	1,obj.5	Recall
62	a	X	0	0	1	.67	1,obj.5	Recall
63	c	0	0	X	0	1.00	1,obj.6	Recall
64	a	X	0	1	0	.67	1,obj.6	Recall
65	d	2	0	0	X	.50	1,obj.6	Recall
66	a	X	0	0	1	.67	1,obj.10	Recall
67	b	1	X	1	1	.40	1,obj.3	Recall
68	b	1	X	0	0	.67	1,obj.2	Recall
69	c	0	1	X	0	.67	1,obj.1	Recall
70	c	0	0	X	2	.50	1,obj.4	Recall
71	d	1	0	0	X	.67	1,obj.2	Recall
72	b	0	X	0	0	1.00	1,obj.2	Recall
73	d	0	0	0	X	1.00	1,obj.7	Interpret.
74	d	0	0	1	X	.67	1,obj.7	Interpret.
75	d	1	0	0	X	.67	1,obj.1	Interpret.
76	b	1	X	0	0	.67	1,obj.2	Interpret.
77	d	1	0	0	X	.67	1,obj.3	Interpret.
78	d	1	1	0	X	.50	1,obj.3	Interpret.
79	c	1	1	X	0	.50	1,obj.7	Interpret.
80	b	1	X	0	0	.67	1,obj.7	Interpret.
81	d	0	2	0	X	.50	1,obj.7	Interpret.
82	c	1	0	X	0	.67	1,obj.6	Interpret.
83	c	0	1	X	0	.67	1,obj.7	Interpret.
84	c	0	1	X	1	.50	1,obj.1	Interpret.
85	c	2	0	X	1	.40	1,obj.4	Interpret.
86	b	0	X	2	0	.50	1,obj.7	Interpret.
87	d	0	0	1	X	.67	1,obj.2	Prob. Solv.
88	a	X	1	0	0	.67	1,obj.6	Prob. Solv.
89	a	X	0	0	2	.50	1,obj.7	Prob. Solv.
90	d	0	0	0	X	1.00	1,obj.6	Prob. Solv.

MLT-A

Question Number	Correct Answer	Crit. Ref. a	b	c	d	MPI	Grid Reference	Taxonomy Level
Other bacteria (5)								
91	c	0	0	X	0	1.00	2,obj.2	Recall
92	b	0	X	1	1	.50	2,obj.5	Recall
93	b	0	X	1	1	.50	3,obj.3	Recall
94	c	0	1	X	1	.50	2,obj.7	Interpret.
95	c	0	0	X	0	1.00	2,obj.3	Interpret.
Mycobacteria (5)								
96	c	1	1	X	0	.50	5,obj.2	Recall
97	d	1	0	0	X	.67	5,obj.10	Recall
98	b	0	X	2	0	.50	5,obj.1	Recall
99	d	0	1	1	X	.50	5,obj.7	Interpret.
100	b	1	X	0	0	.67	5,obj.2	Interpret.
Processing (18)								
101	c	0	0	X	2	.50	IVA1	Recall
102	c	0	0	X	1	.67	IVA1	Recall
103	b	0	X	1	0	.67	IVA2	Recall
104	c	0	0	X	1	.67	IVA2	Recall
105	b	0	X	1	0	.67	IVA3	Recall
106	c	0	1	X	1	.50	IVA3	Recall
107	c	0	0	X	1	.67	IVA4	Recall
108	d	1	0	0	X	.67	IVA2	Recall
109	d	0	0	0	X	1.00	IVA5	Recall
110	c	0	1	X	0	.67	IVA5	Recall
111	c	1	1	X	1	.40	IVA1	Interpret.
112	c	1	0	X	0	.67	IVA4	Interpret.
113	a	X	0	0	0	1.00	IVA3	Interpret.
114	c	0	1	X	0	.67	IVA3	Interpret.
115	b	1	X	0	0	.67	IVA4	Interpret.
116	a	X	0	0	0	1.00	IVA1	Interpret.
117	c	0	1	X	0	.67	IVA3	Prob. Solv.
118	d	1	1	1	X	.40	IVA5	Prob. Solv.
Susceptibility Testing (17)								
119	b	1	X	0	2	.40	IVB1	Recall
120	a	X	0	2	1	.40	IVB1	Recall
121	d	0	1	2	X	.40	IVB2	Recall
122	c	0	0	X	1	.67	IVB2	Recall
123	a	X	0	0	0	1.00	IVB2	Recall
124	d	0	1	0	X	.67	IVB2	Recall
125	c	0	0	X	1	.67	IVB2	Recall
126	c	0	0	X	0	1.00	IVB2	Recall
127	a	X	0	1	0	.67	IVB2	Recall

MLT-A

Question Number	Correct Answer	Crit. Ref.				MPI	Grid Reference	Taxomony Level
		a	b	c	d			
128	b	1	X	0	0	.67	IVB2	Interpret.
129	d	0	0	2	X	.50	IVB2	Interpret.
130	b	0	X	0	0	1.00	IVB2	Interpret.
131	d	0	2	0	X	.50	IVB2	Interpret.
132	b	0	X	0	2	.50	IVB2	Interpret.
133	a	X	0	0	1	.67	IVB2	Interpret.
134	d	1	1	0	X	.50	IVB2	Prob. Solv.
135	b	0	X	1	0	.67	IVB2	Prob. Solv.

Quality Control, Epidemiology, Safety (15)

Question Number	Correct Answer	Crit. Ref.				MPI	Grid Reference	Taxomony Level
		a	b	c	d			
136	c	0	1	X	1	.50	IVA6b	Recall
137	c	0	0	X	1	.67	IVA6b	Recall
138	b	1	X	1	0	.50	IVC1	Recall
139	c	0	0	X	1	.67	IVC1	Recall
140	c	0	1	X	1	.50	IVC6	Recall
141	c	0	1	X	0	.67	IVD1a	Recall
142	d	1	0	0	X	.67	IVD2	Recall
143	c	0	0	X	0	1.00	IVE1	Recall
144	d	1	1	1	X	.40	IVA6b	Interpret.
145	c	1	0	X	0	.67	IVC3	Interpret.
146	d	1	1	0	X	.50	IVC7	Interpret.
147	c	0	1	X	0	.67	IVD1b	Interpret.
148	c	0	0	X	0	1.00	IVE6	Interpret.
149	a	X	1	0	0	.67	IVD1c	Prob. Solv.
150	b	0	X	1	2	.40	IVD1d	Prob. Solv.

Mycology (20)

Question Number	Correct Answer	Crit. Ref.				MPI	Grid Reference	Taxomony Level
		a	b	c	d			
151	d	1	1	1	X	.40	IA	Recall
152	c	1	0	X	1	.50	IIB	Recall
153	b	0	X	0	1	.67	IIIB	Recall
154	a	X	1	1	0	.50	IIID	Recall
155	c	1	0	X	0	.67	IVA	Recall
156	a	X	0	0	1	.67	VB	Recall
157	b	0	X	1	0	.67	IIB	Recall
158	b	1	X	1	1	.40	IXA	Recall
159	b	0	X	0	0	1.00	IXB	Recall
160	c	0	0	X	1	.67	IXE	Recall
161	d	0	0	0	X	1.00	IXE	Recall
162	c	1	0	X	0	.67	IIA	Interpret.
163	b	1	X	1	0	.50	IIB	Interpret.
164	c	0	1	X	0	.50	IIIC	Interpret.
165	b	0	X	1	0	.67	IXD	Interpret.

MLT-A

Question Number	Correct Answer	Crit. Ref.				MPI	Grid Reference	Taxonomy Level
		a	b	c	d			
166	d	0	1	0	X	.67	IXA	Interpret.
167	a	X	0	1	0	.67	IXB	Interpret.
168	a	X	0	0	0	1.00	IXC	Interpret.
169	c	1	0	X	0	.67	IXA	Prob. Solv.
170	d	0	0	1	X	.67	IXB	Prob. Solv.
Parasitology (30)								
171	c	0	1	X	0	.67	IA(A)	Recall
172	a	X	1	0	1	.50	IA(A)	Recall
173	d	1	0	0	X	.67	IB1(B)	Recall
174	d	0	0	0	X	1.00	II1a1(F)	Recall
175	a	X	0	0	0	1.00	II1c(C)	Recall
176	b	1	X	0	0	.67	II1a2(B)	Recall
177	c	0	1	X	0	.67	II2a(C)	Recall
178	b	1	X	0	0	.67	II2c(F)	Recall
179	b	1	X	1	0	.50	II2e1(B)	Recall
180	c	0	0	X	1	.67	II4a1(C)	Recall
181	b	0	X	0	0	1.00	III1a(F)	Recall
182	d	0	0	0	X	1.00	III1e(D)	Recall
183	c	1	0	X	0	.67	III1j(D)	Recall
184	c	0	0	X	0	1.00	III2e(D)	Recall
185	c	0	0	X	0	1.00	III3a(D)	Recall
186	a	X	1	0	0	.67	VA1b(A)	Recall
187	d	0	0	0	X	1.00	VA2bcd(C)	Recall
188	d	0	0	0	X	1.00	IB1(B)	Interpret.
189	b	0	X	0	0	1.00	IB1(B)	Interpret.
190	c	0	0	X	0	1.00	II1d(C)	Interpret.
191	d	0	0	1	X	.67	II1d(C)	Interpret.
192	b	0	X	0	0	1.00	II2b(F)	Interpret.
193	b	0	X	0	0	1.00	II4a3(BDE)	Interpret.
194	c	0	0	X	0	1.00	III1b(BD)	Interpret.
195	a	X	0	0	1	.67	III2b(D)	Interpret.
196	b	0	X	1	0	.67	II2a(D)	Interpret.
197	d	0	0	0	X	1.00	VA2a(C)	Interpret.
198	c	1	0	X	0	.67	II1(B)	Prob. Solv.
199	a	X	0	0	1	.67	II1(F)	Prob. Solv.
200	d	1	0	0	X	.67	III2cd(CD)	Prob. Solv.

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MLT-B

Question Number	Correct Answer	Crit. Ref a	b	c	d	MPI	Grid Reference	Taxonomy Level
Enteric & Nonfastidious Gram Negative Rods (35)								
1	d	1	0	0	X	.67	IIA2	Recall
2	b	0	X	0	0	1.00	IIB1	Recall
3	d	0	0	0	X	1.00	IIB1	Recall
4	c	0	0	X	0	1.00	IIB1	Recall
5	d	0	0	2	X	.50	IIB1	Recall
6	b	0	X	1	0	.67	IIB2	Recall
7	a	X	0	0	0	1.00	IIB3	Recall
8	b	0	X	0	0	1.00	IIB3	Recall
9	d	0	0	0	X	1.00	IIB3	Recall
10	d	1	0	0	X	.67	IIB3	Recall
11	d	0	0	0	X	1.00	IIC1	Recall
12	d	0	0	0	X	1.00	IIC1	Recall
13	a	X	0	1	1	.50	IIC1	Recall
14	c	0	0	X	0	1.00	IIC1	Recall
15	a	X	0	0	0	1.00	IIC1	Recall
16	d	0	0	0	X	1.00	IIC1	Recall
17	d	0	1	0	X	.67	IIC2	Recall
18	c	0	0	X	0	1.00	IID2	Recall
19	d	1	0	0	X	.67	IID3	Recall
20	c	0	0	X	0	1.00	IIA2	Interpret.
21	b	1	X	1	0	.50	IIB1	Interpret.
22	c	0	1	X	0	.67	IIB1	Interpret.
23	d	0	0	0	X	1.00	IIB1	Interpret.
24	a	X	0	0	1	.67	IIB3	Interpret.
25	c	0	1	X	0	.67	IIB3	Interpret.
26	b	0	X	2	0	.50	IIC1	Interpret.
27	d	0	0	0	X	1.00	IIC1	Interpret.
28	b	0	X	0	0	1.00	IIC1	Interpret.
29	a	X	0	0	1	.67	IIC1	Interpret.
30	a	X	1	0	0	.67	IIC2	Interpret.
31	a	X	1	0	0	.67	IIC2	Interpret.
32	b	0	X	2	0	.50	IIB1	Prob. Solv.
33	d	0	0	1	X	.67	IIB3	Prob. Solv.
34	d	0	1	0	X	.67	IIC1	Prob. Solv.
35	c	0	1	X	0	.67	IIC1	Prob. Solv.
Anaerobes (15)								
36	a	X	2	0	0	.50	IA1	Recall
37	c	0	0	X	2	.50	IA2	Recall
38	b	2	X	0	2	.33	IB1	Recall
39	c	0	0	X	0	1.00	IB2	Recall
40	c	0	1	X	0	.67	IB3	Recall
41	a	X	0	1	0	.67	IC1	Recall
42	a	X	2	0	0	.50	ID1	Recall
43	d	0	0	0	X	1.00	ID3	Recall
44	c	0	0	X	1	.67	IA1	Interpret.

Question Number	Correct Answer	Crit. Ref a	b	c	d	MPI	Grid Reference	Taxonomy Level
45	c	1	1	X	0	.50	IB1	Interpret.
46	a	X	2	1	0	.40	IB1	Interpret.
47	a	X	1	0	0	.67	IA1	Interpret.
48	c	0	1	X	0	.67	ID1	Interpret.
49	a	X	2	1	0	.40	ID2	Interpret.
50	b	1	X	0	0	.67	IA2	Prob. Solv.

Staph, Strep, Neis., Hemophilus (40)

Question Number	Correct Answer	Crit. Ref a	b	c	d	MPI	Grid Reference	Taxonomy Level
51	a	X	0	0	2	.50	1,obj.1	Recall
52	a	X	0	0	0	1.00	1,obj.1	Recall
53	b	0	X	0	0	1.00	1,obj.2	Recall
54	b	0	X	0	0	1.00	1,obj.3	Recall
55	b	0	X	0	1	.67	1,obj.3	Recall
56	d	1	1	1	X	.40	1,obj.3	Recall
57	b	0	X	1	1	.50	1,obj.4	Recall
58	d	0	0	1	X	.67	1,obj.4	Recall
59	d	0	0	0	X	1.00	1,obj.4	Recall
60	d	0	0	0	X	1.00	1,obj.4	Recall
61	d	1	0	0	X	.67	1,obj.5	Recall
62	c	0	1	X	0	.67	1,obj.5	Recall
63	c	0	0	X	0	1.00	1,obj.5	Recall
64	c	0	0	X	1	.67	1,obj.6	Recall
65	a	X	0	0	0	1.00	1,obj.6	Recall
66	d	2	0	0	X	.50	1.obj.6	Recall
67	a	X	0	0	1	.67	1,obj.10	Recall
68	a	X	0	0	0	1.00	1,obj.2	Recall
69	b	1	X	1	1	.40	1,obj.3	Recall
70	b	1	X	0	0	.67	1,obj.2	Recall
71	b	0	X	0	0	1.00	1,obj.1	Recall
72	b	0	X	0	0	1.00	1,obj.2	Recall
73	c	0	0	X	0	1.00	1,obj.7	Interpret.
74	d	0	0	0	X	1.00	1,obj.7	Interpret.
75	d	1	0	0	X	.67	1,obj.1	Interpret.
76	d	2	0	0	X	.50	1,obj.1	Interpret.
77	c	0	0	X	0	1.00	1,obj.3	Interpret.
78	a	X	0	0	0	1.00	1,obj.3	Interpret.
79	d	1	0	1	X	.50	1,obj.6	Interpret.
80	c	1	1	X	0	.50	1,obj.7	Interpret.
81	a	X	0	0	0	1.00	1,obj.7	Interpret.
82	b	1	X	0	0	.67	1,obj.2	Interpret.
83	b	1	X	0	0	.67	1,obj.7	Interpret.
84	d	1	0	0	X	.67	1,obj.6	Interpret.
85	c	0	1	X	0	.67	1,obj.7	Interpret.
86	d	1	1	0	X	.50	1,obj.1	Interpret.
87	b	1	X	0	0	.67	1,obj.2	Prob. Solv.
88	c	0	0	X	0	1.00	1,obj.3	Prob. Solv.
89	c	0	0	X	0	1.00	1,obj.6	Prob. Solv.
90	d	0	0	0	X	1.00	1,obj.6	Prob. Solv.

MLT-B

Question Number	Correct Answer	Crit. Ref a	b	c	d	MPI	Grid Reference	Taxonomy Level
Other bacteria (5)								
91	c	1	0	X	1	.50	2,obj.5	Recall
92	d	0	2	0	X	.40	2,obj.2	Recall
93	d	0	1	1	X	.50	3,obj.2	Recall
94	a	X	0	0	0	1.00	2,obj.2	Interpret.
95	c	0	0	X	1	.67	2,obj.1	Interpret.
Mycobacterium (5)								
96	d	1	0	0	X	.67	5,obj.2	Recall
97	b	1	X	0	0	.67	5,obj.1	Recall
98	c	0	0	X	0	1.00	5,obj.10	Recall
99	b	0	X	0	0	1.00	5,obj.2	Interpret.
100	c	1	0	X	0	.67	5,obj.4	Interpret.
Processing (18)								
101	b	1	X	0	0	.67	IVA1	Recall
102	b	0	X	0	0	1.00	IVA1	Recall
103	b	0	X	1	0	.67	IVA2	Recall
104	c	0	0	X	0	1.00	IVA2	Recall
105	d	0	0	2	X	.50	IVA3	Recall
106	b	0	X	1	0	.67	IVA3	Recall
107	c	0	0	X	1	.67	IVA4	Recall
108	c	0	0	X	0	1.00	IVA4	Recall
109	c	0	0	X	0	1.00	IVA5	Recall
110	b	0	X	0	0	1.00	IVA5	Recall
111	d	1	0	0	X	.67	IVA1	Interpret.
112	c	0	0	X	0	1.00	IVA2	Interpret.
113	a	X	0	0	1	.67	IVA2	Interpret.
114	a	X	0	0	0	1.00	IVA3	Interpret.
115	c	0	1	X	0	.67	IVA3	Interpret.
116	a	X	0	0	1	.67	IVA5	Interpret.
117	b	0	X	0	0	1.00	IVA3	Prob. Solv.
118	b	1	X	0	0	.67	IVA4	Prob. Solv.
Susceptibility (17)								
119	d	0	0	1	X	.67	IVB1	Recall
120	b	1	X	2	0	.40	IVB1	Recall
121	c	0	0	X	0	1.00	IVB2	Recall
122	b	0	X	0	0	1.00	IVB2	Recall
123	a	X	1	0	0	.67	IVB2	Recall
124	d	0	0	1	X	.67	IVB2	Recall
125	b	0	X	0	0	1.00	IVB2	Recall
126	a	X	0	0	0	1.00	IVB2	Recall
127	c	0	1	X	0	.67	IVB2	Recall
128	c	0	0	X	2	.50	IVB2	Interpret.
129	b	0	X	0	1	.67	IVB2	Interpret.
130	d	0	0	0	X	1.00	IVB2	Interpret.
131	b	0	X	0	2	.50	IVB2	Interpret.
132	b	0	X	0	2	.50	IVB2	Interpret.

MLT-B

Question Number	Correct Answer	Crit. Ref				MPI	Grid Reference	Taxonomy Level
		a	b	c	d			
133	a	X	0	0	0	1.00	IVB2	Interpret.
134	d	0	0	2	X	.50	IVB2	Prob. Solv.
135	d	0	2	0	X	.50	IVB2	Prob. Solv.
Safety, Epidemiology, Quality Control (15)								
136	c	0	0	X	1	.67	IVA6b	Recall
137	b	1	X	1	1	.40	IVA6b	Recall
138	d	0	0	0	X	1.00	IVA6a	Recall
139	c	0	2	X	1	.40	IVC1	Recall
140	d	0	1	1	X	.50	IVC3	Recall
141	c	0	1	X	0	.67	IVC4	Recall
142	a	X	0	0	2	.50	IVD1a	Recall
143	b	0	X	0	0	1.00	IVD2	Recall
144	b	1	X	0	0	.67	IVE3	Recall
145	a	X	1	1	1	.40	IVA6b	Interpret.
146	b	1	X	0	0	.67	IVA6b	Interpret.
147	a	X	1	1	0	.50	IVD3	Interpret.
148	d	0	0	0	X	1.00	IVE4	Interpret.
149	b	2	X	1	0	.40	IVD1d	Interpret.
150	b	0	X	0	0	1.00	IVd1c	Prob. Solv.
Mycology (20)								
151	a	X	1	0	0	.67	IB	Recall
152	a	X	0	1	0	.67	IIB	Recall
153	a	X	1	0	0	.67	IIIC	Recall
154	a	X	1	0	0	.67	IVA	Recall
155	b	0	X	1	1	.50	VIA	Recall
156	b	0	X	1	0	.67	IIB	Recall
157	c	2	0	X	0	.50	IIID	Recall
158	a	X	1	1	1	.40	IXA	Recall
159	d	0	0	0	X	1.00	IXA	Recall
160	b	1	X	0	0	.67	IXB	Recall
161	a	X	0	0	0	1.00	IXE	Recall
162	b	0	X	1	0	.67	IIA	Interpret.
163	b	1	X	1	0	.50	IIB	Interpret.
164	c	0	1	X	1	.50	IIIC	Interpret.
165	b	0	X	1	0	.67	IVB	Interpret.
166	b	2	X	0	0	.50	IXC	Interpret.
167	b	0	X	0	0	1.00	IXE	Interpret.
168	d	1	0	2	X	.40	IXA	Interpret.
169.	b	1	X	1	0	.50	IXA	Prob. Solv.
170	d	1	0	0	X	.67	IXB	Prob. Solv.
Parasitology (30)								
171	a	X	0	1	0	.67	IA(A)	Recall
172	b	0	2	X	0	.50	IB2(B)	Recall
173	b	0	X	1	0	.67	IB1(B)	Recall
174	c	0	0	X	0	1.00	II1a1(F)	Recall

MLT-B

Question Number	Correct Answer	Crit. Ref a	b	c	d	MPI	Grid Reference	Taxonomy Level
175	c	0	0	X	0	1.00	II1c(C)	Recall
176	b	0	X	0	1	.67	II1c(C)	Recall
177	b	1	X	0	0	.67	II2a(C)	Recall
178	c	0	1	X	0	.67	II2(A)	Recall
179	b	1	X	0	0	.67	II2a(D)	Recall
180	b	0	X	0	0	1.00	II4a(3)(C)	Recall
181	d	0	0	2	X	.50	II4b(E)	Recall
182	b	0	X	0	0	1.00	III1a(F)	Recall
183	d	0	0	0	X	1.00	III1cfg(D)	Recall
184	d	0	0	0	X	1.00	III1e(D)	Recall
185	b	1	X	0	0	.67	III2e(G)	Recall
186	d	0	0	0	X	1.00	III3b(G)	Recall
187	d	0	0	1	X	.67	VA1e(A)	Recall
188	c	0	0	X	0	1.00	IB1(B)	Interpret.
189	d	0	0	0	X	1.00	IB1(B)	Interpret.
190	a	X	0	0	0	1.00	III1d(C)	Interpret.
191	b	0	X	0	0	1.00	II1d(C)	Interpret.
192	d	0	0	2	X	.50	II4a3(BDF)	Interpret.
193	c	0	0	X	0	1.00	III1e	Interpret.
194	a	X	0	2	0	.50	VA2	Interpret.
195	a	X	0	0	1	.67	A2a(D)	Interpret.
196	d	1	0	0	X	.67	VAA2a(C)	Interpret.
197	c	0	1	X	1	.50	VA2	Interpret.
198	a	X	0	1	0	.67	VA2	Prob. Solv.
199	a	X	0	0	1	.67	II1	Prob. Solv.
200	a	X	0	2	0	.50	III2cd(CD)	Prob. Solv.

MPL= 167.75

MT-A

Question Number	Correct Answer	Crit. Ref.				MPI	Grid Reference	Taxonomy Level
		a	b	c	d			
Enteric & Nonfastidious Gram Negative Rods (35)								
1	a	X	0	0	0	1.00	IIA2	Recall
2	d	0	0	0	X	1.00	IIB1	Recall
3	c	0	0	X	1	.67	IIB1	Recall
4	b	0	X	2	0	.50	IIB2	Recall
5	d	1	0	0	X	.67	IIB3	Recall
6	b	0	X	0	0	1.00	IIC1	Recall
7	a	X	0	0	0	1.00	IIC1	Recall
8	a	X	1	1	0	.50	IIC1	Recall
9	b	0	X	0	0	1.00	IIC1	Recall
10	a	X	0	0	1	.67	IIB1	Interpret.
11	b	0	X	0	0	1.00	IIB1	Interpret.
12	b	0	X	0	1	.67	IIB1	Interpret.
13	a	X	0	0	0	1.00	IIB1	Interpret.
14	b	0	X	0	0	1.00	IIB1	Interpret.
15	a	X	0	0	0	1.00	IIB3	Interpret.
16	a	X	0	0	0	1.00	IIB3	Interpret.
17	c	0	0	X	0	1.00	IIC1	Interpret.
18	d	0	0	0	X	1.00	IIC1	Interpret.
19	c	0	0	X	0	1.00	IIC1	Interpret.
20	a	X	0	2	0	.50	IIC1	Interpret.
21	d	0	0	0	X	1.00	IIC1	Interpret.
22	d	0	0	0	X	1.00	IIC2	Interpret.
23	d	0	1	1	X	.50	IIC1	Interpret.
24	b	2	X	0	0	.50	IIB1	Interpret.
25	c	0	0	X	0	1.00	IIB1	Prob. Solv.
26	b	0	X	0	1	.67	IIB1	Prob. Solv.
27	c	0	0	X	0	1.00	IIB1	Prob. Solv.
28	d	0	0	0	X	1.00	IIB2	Prob. Solv.
29	d	0	0	0	X	1.00	IIB3	Prob. Solv.
30	a	X	I	0	0	.67	IIB3	Prob. Solv.
31	b	0	X	0	0	1.00	IIB3	Prob. Solv.
32	a	X	0	0	0	1.00	IIC1	Prob. Solv.
33	b	0	X	0	0	1.00	IIC1	Prob. Solv.
34	c	2	0	X	0	.50	IIC1	Prob. Solv.
35	c	0	0	X	0	1.00	IIC2	Prob. Solv.
Anaerobes (15)								
36	b	0	X	0	0	1.00	IA1	Recall
37	b	0	X	0	0	1.00	IB1	Recall
38	d	1	1	1	X	.40	IB2	Recall
39	b	0	X	0	0	1.00	IC2	Recall
40	a	X	0	1	0	.67	IA1	Interpret.
41	d	0	0	0	X	1.00	IA2	Interpret.
42	a	X	0	0	0	1.00	IB1	Interpret.
43	a	X	0	0	0	1.00	IB3	Interpret.
44	b	1	X	0	0	.67	IC1	Interpret.
45	c	0	0	X	0	1.00	ID1	Interpret.

MT-A

Question Number	Correct Answer	Crit. Ref.				MPI	Grid Reference	Taxonomy Level
		a	b	c	d			
46	a	X	1	0	1	.50	IA1	Prob. Solv.
47	d	0	1	0	X	.67	IA2	Prob. Solv.
48	d	0	0	1	X	.67	IB2	Prob. Solv.
49	b	0	X	0	0	1.00	IC1	Prob. Solv.
50	c	0	0	X	2	.50	ID2	Prob. Solv.
Staph., Strep., Neis., Hemophilus (30)								
51	a	X	0	0	0	1.00	1,obj.1	Recall
52	b	1	X	0	0	.67	1,obj.2	Recall
53	a	X	0	0	0	1.00	1,obj.3	Recall
54	c	0	0	X	1	.67	1,obj.4	Recall
55	a	X	0	0	0	1.00	1,obj.5	Recall
56	c	0	0	X	0	1.00	1,obj.6	Recall
57	b	0	X	0	0	1.00	1,obj.8	Recall
58	c	0	0	X	0	1.00	1,obj.7	Interpret.
59	c	0	0	X	0	1.00	1,obj.1	Interpret.
60	a	X	1	0	0	.67	1,obj.2	Interpret.
61	c	0	0	X	0	1.00	1,obj.10	Interpret.
62	c	0	0	X	0	1.00	1,obj.2	Interpret.
63	c	0	0	X	0	1.00	1,obj.6	Interpret.
64	d	0	1	0	X	.67	1,obj.7	Interpret.
65	b	0	X	0	0	1.00	1,obj.7	Interpret.
66	b	0	X	0	0	1.00	1,obj.7	Interpret.
67	d	0	0	0	X	1.00	1,obj.9	Interpret.
68	a	X	0	0	0	1.00	1,obj.11	Interpret.
69	b	0	X	0	0	1.00	1,obj.7	Interpret.
70	c	1	0	X	0	.67	1,obj.3	Prob. Solv.
71	b	0	X	0	0	1.00	1,obj.2	Prob. Solv.
72	c	0	0	X	0	1.00	1,obj.4	Prob. Solv.
73	d	0	1	0	X	.67	1,obj.4	Prob. Solv.
74	b	1	X	0	0	.67	1,obj.10,11	Prob. Solv.
75	d	1	1	1	X	.40	1,obj.12	Prob. Solv.
76	a	X	0	0	1	.67	1,obj.7	Prob. Solv.
77	d	2	0	0	X	.50	1,obj.2	Prob. Solv.
78	a	X	0	0	0	1.00	1,obj.7,8	Prob. Solv.
79	b	0	X	0	0	1.00	1,obj.3	Prob. Solv.
80	d	0	0	0	X	1.00	1,obj.1	Prob. Solv.
Other bacteria (10)								
81	a	X	0	0	0	1.00	2,obj.2	Recall
82	c	0	0	X	0	1.00	3,obj.1	Recall
83	a	X	1	0	1	.50	4,obj.2	Recall
84	c	0	1	X	0	.67	2,obj.1,11	Interpret.
85	d	0	0	0	X	1.00	2,obj.3,11	Interpret.
86	c	0	1	X	0	.67	3,obj.5	Interpret.
87	d	0	1	1	X	.50	4,obj.1	Interpret.
88	b	0	X	0	0	1.00	2,obj.12	Prob. Solv.
89	d	0	1	1	X	.50	2,obj.7,11	Prob. Solv.
90	d	1	1	1	X	.40	3,obj.2,11	Prob. Solv.

MT-A

Question Number	Correct Answer	Crit. Ref. a	b	c	d	MPI	Grid Reference	Taxonomy Level
Mycobacterium (10)								
91	d	0	1	0	X	.67	5,obj.4	Recall
92	b	0	X	1	0	.67	5,obj.1	Recall
93	b	0	X	0	1	.67	5,obj.2	Interpret.
94	b	0	X	0	1	.67	5,obj.3	Interpret.
95	b	1	X	0	0	.67	5,obj.3	Interpret.
96	b	0	X	0	0	1.00	5,obj.6,7	Interpret.
97	a	X	2	0	0	.50	5,obj.7,12	Prob. Solv.
98	d	0	1	0	X	.67	5,obj.2	Prob. Solv.
99	d	1	1	1	X	.40	5,obj.11	Prob. Solv.
100	d	0	2	0	X	.50	5,obj.10	Prob. Solv.
Processing (18)								
101	d	0	0	0	X	1.00	IVA1	Recall
102	b	0	X	0	1	.67	IVA1	Recall
103	b	0	X	1	0	.67	IVA3	Recall
104	d	0	1	0	X	.67	IVA4	Recall
105	d	0	0	1	X	.67	IVA5	Recall
106	a	X	0	0	0	1.00	IVA3	Interpret.
107	d	0	0	1	X	.67	IVA2	Interpret.
108	c	0	0	X	0	1.00	IVA3	Interpret.
109	c	0	0	X	0	1.00	IVA4	Interpret.
110	c	0	1	X	1	.50	IVA4	Interpret.
111	c	1	1	X	0	.50	IVA5	Interpret.
112	b	1	X	0	0	.67	IVA5	Interpret.
113	c	0	0	X	2	.50	IVA1,3	Prob. Solv.
114	c	1	1	X	0	.50	IVA3	Prob. Solv.
115	d	0	1	0	X	.67	IVA2	Prob. Solv.
116	c	0	1	X	0	.67	IVA3	Prob. Solv.
117	d	1	0	0	X	.67	IVA4	Prob. Solv.
118	b	0	X	0	0	1.00	IVA5	Prob. Solv.
Susceptibility Testing (17)								
119	b	2	X	0	0	.50	IVB1	Recall
120	d	0	0	0	X	1.00	IVB1	Recall
121	c	0	0	X	1	.67	IVB2	Recall
122	d	0	0	0	X	1.00	IVB3	Recall
123	b	0	X	0	2	.50	IVB1	Interpret.
124	b	2	X	1	0	.40	IVB2	Interpret.
125	a	X	0	1	0	.67	IVB2	Interpret.
126	d	0	0	0	X	1.00	IVB2	Interpret.
127	a	X	0	0	0	1.00	IVB2	Interpret.
128	c	0	1	X	0	.67	IVB3	Interpret.
129	b	0	X	1	1	.50	IVB3	Interpret.
130	d	0	0	0	X	1.00	IVB1	Prob. Solv.
131	a	X	1	2	0	.40	IVB2	Prob. Solv.
132	c	0	0	X	0	1.00	IVB2	Prob. Solv.
133	c	0	0	X	0	1.00	IVB2	Prob. Solv.
134	d	0	0	0	X	1.00	IVB3	Prob. Solv.
135	a	X	0	0	0	1.00	IVB3	Prob. Solv.

MT-A

Question Number	Correct Answer	Crit. Ref.				MPI	Grid Reference	Taxonomy Level
		a	b	c	d			
Quality Control, Safety, Epidemiology (15)								
136	d	0	0	2	X	.50	IVA6c	Recall
137	c	0	1	X	0	.67	IVC1	Recall
138	b	1	X	0	0	.67	IVC6	Recall
139	c	0	1	X	0	.67	IVD3	Recall
140	c	0	0	X	0	1.00	IVA6b	Interpret.
141	b	1	X	1	1	.40	IVC2	Interpret.
142	b	0	X	0	0	1.00	IVC3	Interpret.
143	b	0	X	1	1	.50	IVC3	Interpret.
144	d	1	1	1	X	.40	IVD1a	Interpret.
145	c	0	1	X	0	.67	IVD1b	Interpret.
146	d	1	0	0	X	.67	IVA6b	Prob. Solv.
147	d	0	0	1	X	.67	IVA6b	Prob. Solv.
148	d	0	0	2	X	.50	IVC4	Prob. Solv.
149	d	1	0	1	X	.50	IVD1d	Prob. Solv.
150	b	0	X	1	0	.67	IVE4	Prob. Solv.
Mycology (20)								
151	a	X	0	0	0	1.00	IA-A	Recall
152	c	1	0	X	1	.50	IIB-B1c	Recall
153	b	0	X	0	0	1.00	IIE-B2c	Recall
154	d	1	1	0	X	.50	IIIH-B1	Recall
155	d	0	0	0	X	1.00	IIIF-D3	Recall
156	c	0	0	X	0	1.00	IIA-A4	Interpret.
157	c	0	0	X	1	.67	IVB-A2	Interpret.
158	c	0	0	X	2	.50	IIC-B1d5	Interpret.
159	c	1	1	X	2	.33	IIIG-C5	Interpret.
160	d	0	0	0	X	1.00	IVB-B5	Interpret.
161	d	2	1	0	X	.40	VB-D	Interpret.
162	d	0	1	2	X	.40	VIII-A	Interpret.
163	a	X	1	0	0	.67	IXC-D4	Interpret.
164	a	X	1	2	0	.40	IB-B1	Prob. Solv.
165	d	1	1	0	X	.50	IIG-B2d	Prob. Solv.
166	b	1	X	0	1	.50	III-IeD1	Prob. Solv.
167	b	0	X	0	1	.67	IXB-B7	Prob. Solv.
168	c	1	1	X	0	.50	IXD-A4	Prob. Solv.
169	b	0	X	1	1	.50	IXE-B1	Prob. Solv.
170	a	X	0	0	0	1.00	IXB-E13	Prob. Solv.
Parasitology (30)								
171	c	1	0	X	0	.67	IA-A	Recall
172	d	0	0	0	X	1.00	IIC-A1a	Recall
173	c	1	1	X	1	.40	II2b	Recall
174	d	0	0	0	X	1.00	IIID-1a	Recall
175	c	1	1	X	0	.50	IIID-3a	Recall
176	c	1	0	X	0	.67	IVA-F	Recall
177	c	0	0	X	0	1.00	VG-D1	Recall

MT-A

Question Number	Correct Answer	Crit. Ref. a	b	c	d	MPI	Grid Reference	Taxonomy Level
178	d	0	0	1	X	.67	IB-13	Interpret.
179	d	0	1	0	X	.67	IID-A1	Interpret.
180	a	X	0	0	0	1.00	IIC-A1b	Interpret.
181	a	X	0	0	0	1.00	II1d-C	Interpret.
182	b	0	X	1	0	.67	IIC-A2c	Interpret.
183	d	1	0	0	X	.67	II4a3BDE	Interpret.
184	d	0	0	0	X	1.00	IIIA-2e	Interpret.
185	d	0	0	0	X	1.00	II2bF	Interpret.
186	d	0	0	0	X	1.00	II1dC	Interpret.
187	c	1	0	X	1	.50	VC-A2	Interpret.
188	a	X	1	0	0	.67	III2e	Interpret.
189	c	0	1	X	1	.50	II2c1,2	Interpret.
190	d	0	0	0	X	1.00	VA3	Prob. Solv.
191	c	0	0	X	0	1.00	VA2	Prob. Solv.
192	b	0	X	1	0	.67	VD	Prob. Solv.
193	d	0	0	0	X	1.00	III1b	Prob. Solv.
194	d	1	0	1	X	.50	II2e	Prob. Solv.
195	d	0	1	0	X	.67	III1c	Prob. Solv.
196	c	0	0	X	1	.67	VA1a	Prob. Solv.
197	d	0	0	1	X	.67	VC2	Prob. Solv.
198	d	1	0	0	X	.67	VA3	Prob. Solv.
199	d	1	0	0	X	.67	III2c,d	Prob. Solv.
200	c	0	0	X	2	.50	VC1	Prob. Solv.

MPL = 153.5

MT - B

Question Number	Correct Answer	Crit. Ref.				MPI	Grid Reference	Taxonomy Level
		a	b	c	d			
Enteric and Nonfastidious Gram Negative Rods (35)								
1	c	1	1	X	0	.50	IIB1	Recall
2	c	0	0	X	0	1.00	IIB1	Recall
3	d	0	1	1	X	.50	IIB1	Recall
4	b	0	X	1	0	.67	IIB2	Recall
5	a	X	0	0	0	1.00	IIC1	Recall
6	d	0	0	0	X	1.00	IIC1	Recall
7	a	X	1	0	1	.50	IIC1	Recall
8	d	1	0	0	X	.67	IID1	Recall
9	d	0	1	0	X	.67	IIB1	Recall
10	d	0	2	0	X	.50	IIB1	Interpret.
11	b	0	X	2	0	.50	IIB1	Interpret.
12	d	1	0	0	X	.67	IIB1	Interpret.
13	b	1	X	0	0	.67	IIB1	Interpret.
14	a	X	0	0	0	1.00	IIB1	Interpret.
15	a	X	0	0	0	1.00	IIB3	Interpret.
16	a	X	1	0	1	.50	IIB3	Interpret.
17	a	X	0	0	0	1.00	IIC1	Interpret.
18	d	1	0	1	X	.50	IIC1	Interpret.
19	a	X	1	1	1	.40	IIC1	Interpret.
20	c	0	1	X	0	.67	IIC1	Interpret.
21	c	2	0	X	0	.50	IIC1	Interpret.
22	d	1	0	1	X	.50	IIC1	Interpret.
23	a	X	0	1	1	.50	IIC2	Interpret.
24	d	0	0	0	X	1.00	IIB1	Interpret.
25	d	1	0	0	X	.67	IIB1	Prob. Solv.
26	a	X	1	1	0	.50	IIB1	Prob. Solv.
27	b	1	X	2	0	.40	IIB1	Prob. Solv.
28	c	1	0	X	1	.50	IIB3	Prob. Solv.
29	c	0	0	X	1	.67	IIC1	Prob. Solv.
30	d	1	0	1	X	.50	IIB3	Prob. Solv.
31	d	0	0	1	X	.67	IIC1	Prob. Solv.
32	b	1	X	1	0	.50	IIC1	Prob. Solv.
33	b	0	X	1	0	.67	IIC1	Prob. Solv.
34	b	1	X	0	0	.67	IIC1	Prob. Solv.
35	d	0	0	0	X	1.00	IIC2	Prob. Solv.
Anaerobes (15)								
36	c	0	0	X	1	.67	IA2	Recall
37	b	1	X	1	0	.50	IB1	Recall
38	c	1	1	X	0	.50	IB1	Recall
39	c	0	0	X	0	1.00	IB3	Recall
40	b	0	X	1	0	.67	IA1	Interpret.
41	c	0	1	X	0	.67	IA2	Interpret.
42	d	0	0	0	X	1.00	IB1	Interpret.

MT-B

Question Number	Correct Answer	Crit. Ref.				MPI	Grid Reference	Taxonomy Level
		a	b	c	d			
43	b	0	X	0	0	1.00	IB2	Interpret.
44	a	X	0	1	0	.67	IB3	Interpret.
45	d	0	0	0	X	1.00	IB3	Interpret.
46	d	1	0	0	X	.67	IA1	Prob. Solv.
47	b	1	X	1	0	.50	IA1	Prob. Solv.
48	c	0	1	X	0	.67	IB1	Prob. Solv.
49	c	0	1	X	1	.50	IC1	Prob. Solv.
50	d	0	0	0	X	1.00	ID3	Prob. Solv.
Staph., Strep., Neis., Hemophilus (30)								
51	d	0	0	1	X	.67	1,obj.3	Recall
52	a	X	0	0	1	.67	1,obj.3	Recall
53	d	0	0	0	X	1.00	1,obj.4	Recall
54	b	0	X	0	0	1.00	1,obj.5	Recall
55	a	X	0	0	0	1.00	1,obj.5	Recall
56	d	0	0	0	X	1.00	1,obj.6	Recall
57	c	0	0	X	1	.67	1,obj.9	Recall
58	b	0	X	0	0	1.00	1,obj.7	Interpret.
59	c	0	0	X	0	1.00	1,obj.1	Interpret.
60	b	0	X	1	0	.67	1,obj.4	Interpret.
61	a	X	2	0	0	.50	1,obj.10	Interpret.
62	c	1	0	X	0	.67	1,obj.6	Interpret.
63	a	X	1	0	0	.67	1,obj.3	Interpret.
64	d	0	0	0	X	1.00	1,obj.6	Interpret.
65	a	X	0	0	0	1.00	1,obj.7	Interpret.
66	a	X	0	0	0	1.00	1,obj.7	Interpret.
67	b	0	X	1	0	.67	1,obj.8,9,11	Interpret.
68	c	0	0	X	1	.67	1,obj.11	Interpret.
69	c	1	0	X	0	.67	1,obj.4	Interpret.
70	a	X	0	1	0	.67	1,obj.7	Prob. Solv.
71	d	0	0	1	X	.67	1,obj.7	Prob. Solv.
72	c	0	0	X	0	1.00	1,obj.3	Prob. Solv.
73	c	0	1	X	0	.67	1,obj.7	Prob. Solv.
74	c	1	0	X	1	.50	1,obj.11	Prob. Solv.
75	d	0	1	1	X	.50	1,obj.11	Prob. Solv.
76	c	0	0	X	0	1.00	1,obj.12	Prob. Solv.
77	a	X	1	0	0	.67	1,obj.7	Prob. Solv.
78	c	0	0	X	1	.67	1,obj.7,11	Prob. Solv.
79	d	0	0	0	X	1.00	1,obj.12	Prob. Solv.
80	d	0	0	0	X	1.00	1,obj.1	Prob. Solv.
Other Bacteria (10)								
81	a	X	0	0	0	1.00	2,obj.9	Recall
82	d	0	2	1	X	.40	3,obj.10	Recall
83	a	X	0	1	0	.67	4,obj.2	Recall

MT-B

Question Number	Correct Answer	Crit. Ref. a	b	c	d	MPI	Grid Reference	Taxonomy Level
84	b	0	X	0	0	1.00	2,obj.11	Interpret.
85	a	X	1	0	1	.50	2,obj.2,10	Interpret.
86	b	0	X	0	0	1.00	3,obj.1,3	Interpret.
87	b	1	X	0	0	.67	4,obj.2,8	Interpret.
88	c	0	0	X	1	.67	2,obj.2	Prob. Solv.
89	b	1	X	0	0	.67	2,obj.12	Prob. Solv.
90	c	0	0	X	0	1.00	3,obj.11,12	Prob. Solv.
Mycobacterium (10)								
91	d	0	1	0	X	.67	5,obj.10	Recall
92	a	X	0	0	0	1.00	5,obj.2	Recall
93	c	0	0	X	0	1.00	5,obj.2	Interpret.
94	b	0	X	1	0	.67	5,obj.11	Interpret.
95	c	0	1	X	2	.40	5,obj.3	Interpret.
96	c	1	0	X	1	.50	5,obj.4	Interpret.
97	c	1	0	X	0	.67	5,obj.12	Prob. Solv.
98	d	1	0	0	X	.67	5,obj.6,12	Prob. Solv.
99	d	1	1	1	X	.40	5,obj.5	Prob. Solv.
100	d	2	0	0	X	.50	5,obj.4	Prob. Solv.
Processing (18)								
101	c	0	0	X	0	1.00	IVA1	Recall
102	a	X	0	0	0	1.00	IVA2	Recall
103	a	X	2	0	0	.50	IVA2	Recall
104	c	0	0	X	0	1.00	IVA4	Recall
105	d	0	0	0	X	1.00	IVA5	Recall
106	c	0	0	X	0	1.00	IVA3	Interpret.
107	c	0	0	X	0	1.00	IVA1	Interpret.
108	d	0	1	0	X	.67	IVA2	Interpret.
109	c	0	0	X	0	1.00	IVA3	Interpret.
110	c	1	1	X	0	.50	IVA3	Interpret.
111	c	1	1	X	0	.50	IVA4	Interpret.
112	b	0	X	0	0	1.00	IVA5	Interpret.
113	c	1	1	X	0	.50	IVA3	Prob. Solv.
114	d	0	1	0	X	.67	IVA2	Prob. Solv.
115	c	0	0	X	2	.50	IVA1,3	Prob. Solv.
116	c	0	1	X	0	.67	IVA4	Prob. Solv.
117	d	1	1	1	X	.40	IVA5	Prob. Solv.
118	a	X	0	0	0	1.00	IVA5	Prob. Solv.
Susceptibility Testing (17)								
119	d	0	0	1	X	.67	IVB1	Recall
120	d	1	0	1	X	.50	IVB1	Recall
121	b	0	X	0	0	1.00	IVB2	Recall
122	a	X	0	0	0	1.00	IVB3	Recall

MT-B

Question Number	Correct Answer	Crit. Ref.				MPI	Grid Reference	Taxonomy Level
		a	b	c	d			
123	d	1	0	0	X	.67	IVB2	Interpret.
124	a	X	1	1	0	.50	IVB2	Interpret.
125	d	1	0	0	X	.67	IVB2	Interpret.
126	c	0	1	X	0	.67	IVB2	Interpret.
127	c	0	0	X	0	1.00	IVB2	Interpret.
128	d	1	0	0	X	.67	IVB2	Interpret.
129	a	X	0	0	0	1.00	IVB2	Interpret.
130	b	0	X	0	1	.67	IVB1	Prob. Solv.
131	d	0	0	2	X	.50	IVB2	Prob. Solv.
132	a	X	1	0	0	.67	IVB2	Prob. Solv.
133	c	1	1	X	0	.50	IVB2	Prob. Solv.
134	c	1	1	X	1	.40	IVB3	Prob. Solv.
135	b	0	X	1	0	.67	IVB3	Prob. Solv.
Quality Control, Safety, Epidemiology (15)								
136	b	0	X	0	1	.67	IVA6b	Recall
137	c	0	0	X	2	.50	IVC1	Recall
138	b	0	X	0	0	1.00	IVD1	Recall
139	b	1	X	0	1	.50	IVE1	Recall
140	d	0	0	0	X	1.00	IVA6b	Interpret.
141	b	0	X	0	0	1.00	IVC6	Interpret.
142	a	X	1	1	1	.40	IVD3	Interpret.
143	c	0	0	X	0	1.00	IVD1	Interpret.
144	b	1	X	1	0	.50	IVD1	Interpret.
145	b	0	X	1	0	.67	IVE2	Interpret.
146	b	0	X	1	0	.67	IVA6b	Prob. Solv.
147	d	0	1	0	X	.67	IVC7	Prob. Solv.
148	b	1	X	0	1	.50	IVD2b	Prob. Solv.
149	b	2	X	0	0	.50	IVD1d	Prob. Solv.
150	c	1	0	X	1	.50	IVD1c	Prob. Solv.
Mycology (20)								
151	d	1	0	0	X	.67	IA-B5	Recall
152	c	2	0	X	1	.40	IIIB-A6	Recall
153	a	X	0	0	0	1.00	IVA-A6	Recall
154	b	1	X	2	0	.40	IXB-E12	Recall
155	d	0	0	1	X	.67	IIB1b	Recall
156	b	1	X	0	2	.40	IXE-C2	Interpret.
157	a	X	2	0	0	.50	IID-B1e1	Interpret.
158	c	0	0	X	1	.67	IIIJ-B2	Interpret.
159	d	0	0	1	X	.67	IXC-A5	Interpret.
160	b	1	X	2	0	.40	IXB-B6	Interpret.
161	b	0	X	1	0	.67	IXE-E3	Interpret.
162	d	0	0	2	X	.50	XA-C	Interpret.
163	a	X	1	0	1	.50	IXC1,2	Interpret.
164	b	0	X	0	1	.67	IB2	Prob. Solv.
165	b	1	X	0	0	.67	VA-A2	Prob. Solv.

MT-B

Question Number	Correct Answer	Crit.	Ref.			MPI	Grid Reference	Taxonomy Level
		a	b	c	d			
166	d	0	1	1	X	.50	IXA-A3	Prob. Solv.
167	c	1	0	X	1	.50	IIA1	Prob. Solv.
168	d	1	1	0	X	.50	IIIC4	Prob. Solv.
169	c	1	0	X	1	.50	VC-IXB7	Prob. Solv.
170	a	X	0	2	0	.50	IVB2	Prob. Solv.
Parasitology	(30)							
171	d	0	0	0	X	1.00	IIC-1a	Recall
172	d	0	0	0	X	1.00	IIA1a1	Recall
173	a	X	0	0	0	1.00	IIA2a	Recall
174	d	0	1	0	X	.67	IIA4a3	Recall
175	d	0	1	0	X	.67	III1a	Recall
176	c	1	0	X	0	.67	III1g	Recall
177	a	X	0	0	2	.50	II4a	Recall
178	b	0	X	0	0	1.00	IIC-A3	Interpret.
179	b	1	X	0	0	.67	IIID-2a	Interpret.
180	a	X	0	0	0	1.00	IIIC-2b	Interpret.
181	a	X	0	0	0	1.00	IIA1a2	Interpret.
182	d	0	0	0	X	1.00	IIA1a1	Interpret.
183	d	0	0	2	X	.50	II4a1	Interpret.
184	b	0	X	0	0	1.00	III1b	Interpret.
185	b	0	X	0	0	1.00	VD2	Interpret.
186	c	0	1	X	1	.50	VD1	Interpret.
187	a	X	1	1	0	.50	III3c	Interpret.
188	b	1	X	0	0	.67	VB2	Interpret.
189	b	0	X	0	0	1.00	VC1	Interpret.
190	d	0	2	1	X	.40	IIA1e	Prob. Solv.
191	d	0	0	0	X	1.00	IIA2a	Prob. Solv.
192	b	0	X	0	0	1.00	II4a	Prob. Solv.
193	d	1	0	1	X	.50	VB2	Prob. Solv.
194	b	1	X	1	0	.50	IIA1a2	Prob. Solv.
195	c	1	0	X	2	.40	IIA2a,c	Prob. Solv.
196	b	1	X	0	1	.50	VA1a,2d	Prob. Solv.
197	d	0	0	0	X	1.00	VA1	Prob. Solv.
198	b	0	X	1	0	.67	II4a	Prob. Solv.
199	c	2	1	X	1	.33	IVDEF	Prob. Solv.
200	c	1	0	X	0	.67	IIA2b,c	Prob. Solv.

MPL = 141.47

D1

MEDICAL TECHNOLOGY

HEMATOLOGY
EQUIVALENCY EXAMINATION

APRIL 28, 1981

DEPARTMENT OF CLINICAL LABORATORY SCIENCES
COLLEGE OF MEDICINE & DENTISTRY OF NJ
SCHOOL OF ALLIED HEALTH PROFESSIONS
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MT EXAMS

1. The immediate precursor of the segmented neutrophil is the:
   a. Myeloblast
   b. Metamyelocyte
   c. Promyelocyte
   d. Myelocyte

2. Phagocytosis is a characteristic of the following peripheral leukocytes:
   a. Neutrophils, eosinophils, and basophils
   b. Lymphocytes, monocytes, and eosinophils
   c. Basophils, monocytes and neutrophils
   d. Monocytes, eosinophils, and neutrophils

3. Auer rods are derived from:
   a. Lysosome condensation
   b. Abnormal endoplasmic reticulum
   c. Aggregated Golgi bodies
   d. Mitochondrial remnants

4. Sezary cells appear as:
   a. Neutrophils with light blue inclusions
   b. Neutrophils with bilobed nuclei
   c. Monocytes with numerous cytoplasmic granules
   d. Lymphocytes with cerebriform nuclei

5. The normal number of eosinophils in an adult differential is:
   a. 0-1%
   b. 1-3%
   c. 4-8%
   d. 8-13%

6. A "Shift to the left" refers to:
   a. Increased numbers of nuclear lobes in neutrophils
   b. Increased numbers of immature lymphocytes
   c. Increased numbers of young granulocytes
   d. Decreased granulocytes relative to lymphocytes

7. The most important cell product of circulating basophils exposed to specific I_gE stimuli is:
   a. Heparin
   b. Serotonin
   c. Histamine
   d. Lactate dehydrogenase

8. The drumsticks which appear in about 3% of a patient's neutrophils represent:
   a. Abnormal chromosomes in chronic myelocytic leukemia
   b. Denatured nuclear proteins in some autoimmune disorders
   c. "Extra" chromosomes in Klinefelter's syndrome
   d. Inactivated X chromosomes in normal females

9. The areas of the Neubauer hemocytometer used for cell counting in mm^2 are:
   - a. 0.01, 0.1 and 1.0
   - b. 0.2, 1.0 and 3.0
   - c. 0.04, 1.0 and 9.0
   - d. 0.004, 0.1 and 0.9

10. Appropriate specimens for the LE prep include:
    - a. EDTA or heparinized blood
    - b. Heparinized blood or clot
    - c. Sodium citrated or EDTA blood
    - d. Double oxalated blood or clot

11. "Grape" or morula cells in a bone marrow aspirate suggest:
    - a. Infectious mononucleosis
    - b. Severe burns
    - c. Niemann-Pick disease
    - d. Multiple myeloma

12. A Wright's-stained blood film which is excessively pink may be caused by:
    - a. Overstaining
    - b. Thin blood film
    - c. Excess acidity of stain
    - d. Excess alkalinity of stain

13. A 5-year-old girl with symptoms of a high fever and severe headache had a WBC of $17,000/mm^3$. The smear revealed a distinct neutrophilia with Dohle bodies and vacuoles in many of the neutrophils. The most likely cause of these findings is:
    - a. Cryptococcal meningitis
    - b. Toxoplasmosis
    - c. Acute viral influenza
    - d. Acute bacterial infection

14. An 8-year-old boy was admitted to the hospital. His total WBC count was $20,000/mm^3$. The differential showed 75% neutrophils and 15% lymphocytes. These findings indicate a/an:
    - a. Absolute neutrophilia and absolute lymphopenia
    - b. Relative neutrophilia and absolute lymphopenia
    - c. Absolute neutrophilia and relative lymphopenia
    - d. Relative neutrophilia and relative lymphopenia

15. A buffy coat preparation stained by Wright-Giemsa revealed several cells having eccentric nuclei and large amounts of bluish cytoplasm. These cells suggest:
    - a. Hodgkin's disease
    - b. Multiple myeloma
    - c. Infectious mononucleosis
    - d. Mycosis fungiodes

16. Certain morphologic principles are used to evaluate the maturity of individual blood cells. Which cell line seems to contradict these general principles?
    a. Granulocytic
    b. Megakaryocytic
    c. Monocytic
    d. Lymphocytic

17. The best step to eliminate an unacceptable amount of precipitation from blood smears is to:
    a. Make up a new batch of stain
    b. Filter the stain
    c. Wipe slides with clean gauze before making smears
    d. Increase the rinsing time

18. Anticoagulated blood is drawn to the 1.0 mark in the Thoma white cell pipette; diluent is then drawn to the top mark of the mixing bulb. 402 white cells are counted in nine large squares of the Neubauer hemocytometer. The white cell count in mm^3 should be reported as:
    a. 4,467
    b. 8,933
    c. 10,050
    d. 20,100

19. Another name for a monocyte which has ingested nuclear material is a:
    a. L.E. cell
    b. Smudge cell
    c. Tart cell
    d. Macrophage

20. The CBC of an 18-year-old female with malaise and lymphadenopathy revealed a WBC count of 29,000 and a differential of 80% lymphocytes, most of which were atypical. The most likely diagnosis is:
    a. Serum sickness
    b. Lymphoid neoplasm
    c. Infectious mononucleosis
    d. Viral gastroenteritis

21. After leaving the bone marrow, lymphocytes may undergo antigen-independent differentiation in:
    a. Lymph nodules and gut-associated lymphoid tissue
    b. Spleen and thymus
    c. Bursal-equivalent and Thymus
    d. Gut-associated lymphoid tissue and bursal-equivalent

22. Concurrent eosinophilia and basophilia in the absence of clinical symptoms would lead one to suspect a/an:
    a. Latent myeloproliferative disorder
    b. Early anaphylactic reaction
    c. Covert neoplasm
    d. Undiagnosed pernicious anemia

23. The WBC count on a 10-year old was 55,000/mm^3. The differential revealed 70% PMN and 30% immature granulocytes including blasts. The leukocyte alkaline phosphatase reaction was elevated. This is consistent with:
    a. Leukemoid reaction
    b. Myelofibrosis
    c. Acute myelogenous leukemia
    d. Chronic granulocytic leukemia

24. The cells of a routine differential count show pyknotic masses of dark staining material with no visible nuclear chromatin pattern. There is indistinct cytoplasmic granulation. The technologist should:
    a. Disregard the cells
    b. Refer the slide to the chief technologist
    c. Check the requisition for date and time of collection
    d. Notify the patient's physician immediately

25. A slight increase in blasts was observed on a bone marrow smear. Mixed reactions were obtained with peroxidase, Sudan black, and periodic acid Schiff. The technologist noticed that the erythroid precursors were strongly PAS-positive. These findings suggest:
    a. DiGuglielmo's syndrome
    b. Myelomonocytic leukemia
    c. Leukemoid reaction
    d. DiGeorge's syndrome

26. The first of a pair of EDTA blood specimens for an eosinophil count had been collected from the patient in a basal state. A measured ACTH dose was then given intramuscularly. The second specimen was collected four hours later. The basal eosinophil count was 650/mm^3 and the post-ACTH count was 590/mm^3. The results imply:
    a. Cushing's syndrome
    b. Adrenocortical insufficiency
    c. Improper performance of the test
    d. Pituitary imbalance

27. a 23-year old white female was admitted to the hospital for plastic surgery. The routine complete blood count (CBC) was normal. However, the peripheral blood film showed a severe left shift with the majority of neutrophils appearing to be bilobed. Confirmation of the nature of this condition would require:
    a. Specimens from the patient's siblings
    b. A second specimen from the patient
    c. A complete coagulation work-up
    d. A careful history of the patient's use of medications

28. An 11-year-old girl has been referred to the clinic for diagnostic testing. Her mother had earlier intermittent problems with ecchymoses and epistaxes over a period of years. However, the mother had never undergone therapy and was health presently. The gir's peripheral smear revealed very large platelets and cytoplasmic inclusions in many neutrophils. The most likely leukocyte anomaly is that of:
    a. Alder's
    b. Chediak-Higashi
    c. May-Hegglin
    d. Pelger-Huet

29. A 45-year old male endured chronic fatigue and weakness. A mild lymphodenopathy was noted on physical examination. The WBC count was 19,000/mm.^{3} The differential showed 55% lymphocytes characterized by distinctive muclei and gray frayed cytoplasm. The most likely diagnosis is:
    a. Stem cell leukemia
    b. Hairy-cell leukemia
    c. Early lymphocytic leukemia
    d. Lymphoma

30. A 55-year old male had a WBC count of 50,000/mm^3 and a peripheral blood differential count revealed the following:

Neutrophils	12%
Lymphocytes	85%
Monocytes	2%
Eosinophils	1%

These results would be most consistent with a diagnosis of:
    a. Infectious mononucleosis
    b. Acute lymphocytic leukemia
    c. Chronic lymphocytic leukemia
    d. Infectious lymphocytosis

31. An anticoagulant which neutralizes thrombin is:
    a. Oxalate
    b. Ethylenediamine tetra-acetate
    c. Citrate
    d. Heparin

32. Thrombin generation in the extrinsic clotting system requires an adequate level of factor:
    a. I
    b. IX
    c. VII
    d. VIII

33. A patient with Von Willebrand's disease usually has an abnormal:
    a. Platelet count
    b. Fibrinogen level
    c. Bleeding Time
    d. Prothrombin time

34. Activated cephaloplastin reagent contains:
    a. Platelete substitute
    b. Calcium
    c. Factor I
    d. Factor IV

35. A factor which requires vitamin K for hepatic synthesis is:
    a. I
    b. VIII
    c. IX
    d. XI

36. Fibrin split products are formed by:
    a. Action of thrombin on fibrinogen
    b. Splitting of fibrin threads from thrombin
    c. Action of plasmin on fibrin
    d. Dissociation of fibrin monomers

37. A substance which causes platelet aggregation in vitro is:
    a. Ristocetin
    b. Aspirin
    c. Celite
    d. Adenosine

38. The test of choice to detect abnormalities in the extrinsic coagulation pathway is:
    a. Thromboplastin generation test
    b. Prothrombin test (PT)
    c. Activated partial thromboplastin time (APTT)
    d. Bleeding time

39. The APTT is NOT affected by a deficiency of factor:
    a. VII
    b. VIII
    c. IX
    d. XI

40. A platelet count indicative of thrombocytosis is:
   a. 50,000/ul.
   b. 100,000/ul.
   c. 250,000/ul.
   d. 500,000/ul.

41. A factor deficiency which is asymptomatic is:
   a. Hagemann
   b. Stuart-Prower
   c. Plasma thromboplastin antecedent
   d. Platelet factor 3

42. Factor XIII acts primarily by:
   a. Linking fibrin monomers
   b. Inhibiting plasmin activation
   c. Accelerating fibrin polymerization
   d. Splitting off peptides from fibrin

43. An element NOT involved in factor XII acceleration is:
   a. Factor IX
   b. Collagen exposure
   c. Glass contact
   d. Fletcher and Fitzgerald factors

44. A blood smear from an EDTA tube reveals an average of 5-10 platelets per oil immersion field. An approximate platelet estimate per ul would be:
   a. 30,000
   b. 80,000
   c. 186,000
   d. 620,000

45. Aspirin ingestion:
   a. Prolongs the APTT
   b. Lengthens the bleeding time
   c. Decreases the fibrinogen level
   d. Prolongs the PT

46. You perform a PT on an unrefrigerated sample which is four hours old. A likely result might be a value of:
   a. 9.3 secs. due to increased exposure to glass
   b. 10.2 secs. due to platelet aggregation
   c. 14.2 secs. due to Factor V loss
   d. 15.7 secs. due to Factor VII loss

47. Factor X deficiency can be differentiated from factor VII deficiency using the:
   a. PT
   b. Stypven time
   c. Thromboplastin generation test
   d. Prothrombin consumption test

48. A major inadequacy of the whole blood clotting time as a monitor of heparin therapy is its:
   a. Slow contact activation in glass
   b. Sensitivity to heparin
   c. Large blood volume requirement
   d. High cost

49. A major feature of vascular purpura is a/an:
    a. Low platelet count
    b. Normal bleeding time
    c. Abnormal clot retraction
    d. Positive tourniquet test

50. The PT is usually normal in:
    a. Three-day-old infants
    b. von Willebrand's disease
    c. Decompensated cirrhosis of the liver
    d. Patients taking dicumarol

51. Laboratory differentiation between disseminated intravascular coagulation and primary fibrinolysis is based on:
    a. Platelet counts
    b. Fibrin split products
    c. Fibrinogen levels
    d. Prothrombin times

52. The test MOST likely to be inaccurate in the presence of heparin and heparin-like substance is the:
    a. Lee-White clotting time
    b. Prothrobin time
    c. Thrombin time
    d. Euglobulin lysis test

53. Whole blood is diluted 1:100 with ammonium oxalate in a Unopette. 350 platelets are counted in one square millimeter of the counting chamber (Neubauer ruling). The platelet count in mm3 is:
    a. 350
    b. 35,000
    c. 350,000
    d. 3,500,000

54. An untreated patient had a PT of 12 seconds. The PT was 39 seconds within 24 hours after initiation of coumadin therapy. The most probable explanation is:
    a. Concurrent heparin therapy
    b. Normal response
    c. Overreactive response
    d. Excessive dosage

55. A female patient complaining of bruising and excessive menstrual flow has the following coagulation data:

    PT - 12 seconds
    APTT - 65 seconds
    Factor VIII assay - 40% activity
    Factor VIII antigen - decreased
    Bleeding time - 15 minutes

    The results indicate:
    a. von Willebrand's disease
    b. Hemophilia A
    c. Hemophilia B
    d. Parahemophilia

56. A patient's coagulation work-up results were:

Bleeding Time	4 minutes
PT	12.3 seconds (control 11 sec.)
APTT	33 seconds (control 35 sec.)
Platelet Count	50,000/mm^3

You should:
a. Report the results
b. Check the smear and repeat only the platelet count
c. Repeat only the PT and APTT
d. Repeat all the above procedures

57. A five-day old infant developed symptoms of bleeding from the gastrointestinal tract, umbilical stump and skin. The PT and APTT are prolonged but the bleeding time is normal. A condition which might explain this is a:
a. Vitamin K deficiency
b. Vitamin C deficiency
c. Thrombocytopenia
d. Congenital factor defect or decrease

58. A patient began to bleed from a surgical wound three days postoperatively. The coagulation workup gave the following results:

PT	43 seconds (control 11 sec.)
APTT	126 seconds (control 35 sec.)
Fibrinogen level	50 mg./dl.
Platelet count	10,000/ul.

The MOST helpful test to confirm a diagnosis would be:
a. Platelet aggregation studies
b. Thrombin time
c. Fibrin split products level
d. Blood smear examination

59. A coagulation workup on a four-year old boy who complained of bruising and nose bleeds gave the following:

PT	11 seconds (control 12 sec.)
APTT	103 seconds (control 38 sec.)
Bleeding Time	3 minutes

The abnormality was corrected by adsorbed plasma but not by aged serum. The MOST helpful test to establish a definitive diagnosis would be:
a. Platelet factor 3 level
b. Circulating anticoagulants test
c. Factor VIII level
d. Factor IX level

60. To confirm a Fletcher and Fritzgerald factor deficiency as the cause of a patient's prolonged APTT,one should:
a. Decrease the incubation time of the APTT
b. Perform an inactivated APTT
c. Increase the incubation time of the APTT
d. Perform a thrombin time

61. Normal adult hematopoiesis is termed:
a. Ectopic
b. Extramedullary
c. Medullary
c. Myeloid

62. The altered polypeptide chain in most abnormal hemoglobins is the:
    a. Alpha
    b. Beta
    c. Delta
    d. Gamma

63. The sugar water test is useful in diagnosing:
    a. Hypersplenism
    b. Paroxysmal nocturnal hemoglobinuria
    c. Hemoglobinopathies
    d. Hereditary spherocytosis

64. Blood smears which dry too slowly may have artifacts that appear as:
    a. Microcytes
    b. Burr cells
    c. Spherocytes
    d. Parasites

65. Vital staining is required to demonstrate:
    a. Howell-Jolly bodies
    b. Cabot's rings
    c. Malarial parasites
    d. Heinz bodies

66. Erythrocyte color using Wright's stain may be adjusted by:
    a. Changing the buffer pH
    b. Fixing with methanol
    c. Making thinner slides
    d. Rinsing with neutral water

67. The extent of effective erythropoietic activity is assessed most readily by the:
    a. Bone marrow myeloid: erythroid (M:E) ratio
    b. Daily hemoglobin determination
    c. Reticulocyte count
    d. Siderocyte count

68. An increase in polychromatophilia is often accompanied by an increased:
    a. Hemoglobin
    b. Reticulocyte count
    c. Red blood cell count
    d. Hematocrit

69. Sickle cell trait has the two characteristic hemoglobin bands of:
    a. S and C
    b. S and E
    c. S and A
    d. S and S

70. An anatomical site which is NOT used commonly for bone marrow aspirations and biopsy is the:
    a. Sternum
    b. Anterior iliac crest
    c. Posterior iliac crest
    d. Tibia

71. The Schilling test using ^{57} Co ^{B12} is used to determine:
    a. Polycythemia

   b. Spherocytosis
   c. Pernicious anemia
   d. Total blood volume

72. Megaloblastic development implies:
   a. Messenger RNA deficiency
   b. Impaired DNA synthesis
   c. Bone marrow failure
   d. Glucose-6-phosphate dehydrogenase deficiency

73. A laboratory test to differentiate polycythemia vera from secondary polycythemia would be the:
   a. Hematocrit
   b. RBC count
   c. Hemoglobin
   d. LAP stain

74. The initial hemolysis of a patient's erythrocyte fragility test occurred at 0.65% NaCl. It was complete at 0.50% NaCl. This correlates with a blood film containing:
   a. Sickle cells
   b. Spherocytes
   c. Target cells
   d. Macrocytes

75. A patient has a hematocrit of 25%, an hgb of 7g./dl., and a RBC count of 3.6 mil. /mm3. His anemia would be classified as:
   a. Microcytic and hypochromic
   b. Microcytic and normochromic
   c. Normocytic and hypochromic
   d. Normocytic and normochromic

76. A patient's blood has a positive sickle cell screen, 13g/dl of hemoglobin and a single band in the S position in starch gel electrophoresis. He has a normal hematologic history. A possible hemoglobin combination is:
   a. S-thalassemia
   b. S-F
   c. S-D
   e. S-C

77. A jaundiced young female has moderate splenomegaly. The child's mother had undergone a splenectomy as a child for a "blood condition". The lab data reveal a total serum bilirubin of 6 mg./ dl (mostly indirect reacting), an hgb of 6g./dl, an MCV of 81, a MCH of 32, and MCHC of 37. The reticulocyte count is 14.3%. The blood film will probably reveal:
   a. Target cells
   b. Sickle cells
   c. Elliptocytes
   d. Spherocytes

78. Blood for a manual RBC count is diluted 1:100. The number of cells in one-fifth of a square mm. is 200. The RBC count per cu. mm. is:
   a. 1.0 million
   b. 2.0 million
   c. 3.2 million
   d. 4.0 million

79. Polychromatophilia and occasional normoblasts would be found in:
    a. Iron deficiency anemia
    b. Newborns
    c. Aplastic anemia
    d. Polycythemia vera

80. An acid elution test for Hgb F showed an even Hgb F distribution in all the erythrocytes. The most likely cause is:
    a. Thalassemia
    b. Sickle cell anemia
    c. Inherited Hgb F persistence
    d. Hemoglobin F disease

81. A chronically alcoholic patient has a hemoglobin of 10.5 g./dl., a hematocrit of 33%, an MCV of 104 fl. The blood smear had many target cells. The most likely cause of the anemia is:
    a. Iron deficiency
    b. Liver disease
    c. Acute blood loss
    d. Chronic blood loss

82. The hemoglobin and hematocrit on a patient are considerably lower than his earlier results. You would:
    a. Consider overnight hemorrhage and report the results
    b. Confirm the results by another method and report them if they remain unchanged
    c. Check the blood for a clot and consider the sample satisfactory if none is found
    d. Obtain a fresh blood sample, note if the patient is receiving IVs and repeat the assays

83. A patient with an aortic valve prosthesis has a hgb of 7.0 gm/dl. and the peripheral blood smear shows schistocytes. The most likely condition is:
    a. Aplastic anemia
    b. Hemolytic anemia
    c. Megaloblastic anemia
    d. Paroxysmal nocturnal hemoglobinuria

84. The two best procedures to establish a diagnosis in a patient with an MCV of 69 fl. are the:
    a. Serum iron and B_{12} levels
    b. Hemoglobin electrophoresis and direct Coombs
    c. Serum folate and B_{12} levels
    d. Serum iron and hemoglobin electrophoresis

85. A 29 year-old female with no clinical symptoms has the following lab results:

RBC count	4.9 mil./ul
Hematocrit	39%
Hgb	11.3 g/dl

The peripheral smear should target cells and basophilic stippling. The hemoglobin electrophoresis had 93.0% Hgb A, 6.5% Hgb A_2 and 0.5% Hgb F.
The most probable diagnosis is:
    a. A normal state
    b. Beta thalassemia trait
    c. Thalassemia major
    d. Iron deficiency anemia

86. A patient's peripheral blood shows 4+ target cells and occasional basophilic stippling. The blood remains clear in dithionite solution. Hemoglobin electrophoresis on cellulose acetate and agar gel showed 68% Hgb C, 20% Hgb A and 12% Hgb F. The most likely diagnosis is·
    a. Hemoglobin C-thalassemia
    b. Hemoglobin C trait
    c. Homozygous hemoglobin C disease
    d. Hereditary Hgb F persistence

87. A polycythemic blood specimen was done manually by drawing the blood to the 0.3 mark on the pipette and then drawing diluent to the 101 mark. If a routine RBC count is then performed, the usual RBC factor must be adjusted by multiplying it by:
    a. 3/5
    b. 5/3
    c. 1/3
    d. 3

88. A black male taking sulfa drugs for a urinary tract infection complained of general fatigue. His blood count had a hgb of 7.0g./dl., a RBC count of 2.5 mil./mm , a hematocrit of 21%, and a reticulocyte count of 25.0%. His hemoglobin electrophoresis revealed hemoglobin A. He probably has:
    a. Glucose-6-phosphate dehydrogenase deficiency
    b. Hereditary spherocytosis
    c. Paroxysmal nocturnal hemoglobinuria
    d. Hemoglobin C trait

89. A blood film shows nucleated red cells, a moderate number of tear drops and immature myeloid cells. The WBC count is normal with a left shift. The hgb is 8.2g/dl. The likely blood dyscrasia is:
    a. Acquired hemolytic anemia
    b. Thalassemia minor
    c. Lupus erythematosis
    d. Myeloid metaplasia

90. A patient's smear from a venipuncture showed considerable red cell clumping. The best approach to remedy the problem is to:
    a. Add saline to the tube of blood
    b. Obtain a finger puncture smear
    c. Warm the blood sample and slide to 37°C before making the smear
    d. Warm the blood sample and slide to 25°C before making the smear

91. A coefficient of variation on hematocrit results measures:
    a. Accuracy
    b. Precision
    c. Interference
    d. Lab accidents

92. You observe 28 nucleated RBC per 100 WBC on a peripheral smear. The WBC was done on an electronic blood cell counter. You must correct the:
    a. RBC
    b. MCV
    c. WBC
    d. Hgb

93. A directly-measured red cell parameter in an automated hematologic system is the:
    a. Hematocrit
    b. MCV
    c. MCH
    d. MCHC

94. Normal blood will add one white blood cell to a cerebrospinal fluid sample for every:
    a. 50 RBC
    b. 100 RBC
    c. 500 RBC
    d. 1,000 RBC

95. Venous blood specimens are most practical for hematologic studies because:
    a. Capillary blood is not always available
    b. Venipuncture samples have no sampling error
    c. More tests can be performed on a tube of venous blood
    d. Automated cell counters can use only venous samples

96. Liquid EDTA is preferred to powdered EDTA because the former is:
    a. Less susceptible to contamination
    b. Less expensive
    c. More stable
    d. Faster acting

97. Oil is used in hematology microscopy to:
    a. Decrease the resolving power
    b. Adjust the numerical aperture
    c. Reduce light diffraction
    d. Increase focal distance

98. Malfunction of the pneumatic pump on a Coulter S will result in failure of the:
    a. Power supply
    b. Diluter
    c. Spectrophotometer
    d. Printer

99. A unidirectional hemoglobin error that has the same magnitude regardless of concentration is known as·
    a. Random
    b. Systematically constant
    c. Systematically proportional
    d. Discrete

100. If you are required to handle a potentially infectious blood specimen, the best precaution you can take is to:
    a. Decontaminate the specimen
    b. Wear gloves while handling the specimen
    c. Take no additional steps
    d. Wash your hands after handling the specimen

101. An advantage of collecting venous blood by syringe method is that:
    a. No anticoagulant is required
    b. Syringe pressure can be controlled
    c. There is easier penetration of thrombosed veins
    d. Less trauma occurs

102. Leaving a tourniquet on the arm for a long time prior to a venipuncture can cause:
    a. Hemoconcentration
    b. *In vivo* clotting
    c. Venous collapse
    d. Hematoma

103. Two standard deviations in a Gaussian distribution of 200 hemoglobin determinations would include:
    a. 136 results
    b. 172 results
    c. 190 results
    d. 199 results

104. The most common source of aerosol biohazards in the hematology laboratory is:
    a. Centrifuges operated without covers
    b. Blood spilled on countertops
    c. Specimen tubes without stoppers
    d. The process of removing specimen stoppers

105. The most statistically valid erythrocyte determination done manually is the:
    a. Hemoglobin
    b. Erythrocyte count
    c. MCV
    d. Hematocrit

106. 87 WBCs from an undiluted CSF are counted in the entire ruled area on one side of the counting chamber. The count/mm^3 is:
    a. 78
    b. 87
    c. 96
    d. 870

107. A daily hgb control was run for 30 days. The daily results were averaged and a standard deviation was calculated. A mean of 13.9 g/dl. and a standard deviation of 0.17 g/dl. imply that the acceptable range for the control value is:
    a. 13.0 to 14.0 g/dl.
    b. 13.4 to 14.4 g/dl.
    c. 13.6 to 14.2 g/dl.
    d. 13.7 to 14.1 g/dl.

108. A systematic error in a counting procedure would be caused by:
    a. Fibrin clots in specimens
    b. Incomplete specimen sampling
    c. Improper mixing
    d. Incorrect pH of diluent

109. Patient hemoglobins should be checked if they are:
    a. Accompanied by a quality control result outside the acceptable range
    b. Outside ± 2 standard deviations of the control value
    c. Greater than 15 g./dl.
    d. Correlating with the hct, smear and RBC count

110. Acetone in the hematology lab should be stored:
    a. In an location as long as it is in approved safety containers
    b. Only under the laboratory hood
    c. In a well-ventilated area in noncorrosive glass containers
    d. In a well-ventilated area in approved safety cans

111. Three successive CSF tubes from a patient show progressively less bloody fluid so that the third one is clear. The most likely reason is a:
    a. Subarachnoid hemorrhage
    b. Traumatic tap
    c. Xanthochromosis
    d. Extravascular hemorrhage

112. Automated counts are more accurate than manual ones because:
    a. A larger dilution is used
    b. More cells are counted
    c. Nucleated cells are excluded
    d. A better diluent is used

113. A 35.5 x 10^3 WBC count is followed by a 5.2 x 10^3 count on an automated particle counter. One should:
    a. Repeat both counts
    b. Repeat the first count
    c. Repeat the second count
    d. Report the two results

114. A patient's WBC count from an automated particle counter was 20,000/mm^3. You find about five WBC per field under high power in an area where the red cells overlap on the smear. You would:
    a. Call the physician
    b. Report the results
    c. Recheck the cell distribution on the smear
    d. Request another specimen

115. Conistently high background counts were observed during a routine check of the Coulter S. The most appropriate corrective action is to:
    a. Increase the bubble rate
    b. Clean the aperture and sampling valve
    c. Lower the threshold setting
    d. Reset the mercury manometer level

116. A turbid CSF had an increased WBC and protein level. The glucose was decreased. The MOST informative test to determine the patient's condition is:
    a. Gram stain and culture
    b. VDRL
    c. RBC count
    d. Chloride level

117. A patient is receiving IV dextrose and water in the left hand and a transfusion in the antecubital vein of the right arm. To obtain a venous sample for a CBC, you should:
   a. Disconnect the IV and draw blood through the IV needle
   b. Disconnect the transfusion tubing and draw blood through the transfusion needle
   c. Draw blood from the antecubital vein of the left arm
   d. Draw blood from a right wrist or hand vein

118. No platelets in the counting area were found during a differential. You should:
   a. Check the slide for clumping on the edges of the smear
   b. Restick the patient for another smear
   c. Restick the patient for a total platelet count
   d. Send the slide to the pathologist for evaluation

119. A hematology lab which has innaugurated a completly automated hematology system found that most patient indices were outside the normal ranges. The instrument is in good working order. The BEST course of action is to:
   a. Calculate a correction factor for the indices
   b. Revert to previous methodologies
   c. Establish the lab's own normal values for the hospital population
   d. Omit reporting the indices

120. Calculated RBC indices reveal normal values for the MCV and for the MCH but an MCHC of 38%. The RBCs appear normocytic and normochromic on smear; your calculations are correct. You should:
   a. Report the results
   b. Examine another smear
   c. Repeat the RBC count
   d. Repeat the Hgb and Hct

.1.

D1

MEDICAL LABORATORY TECHNOLOGY

HEMATOLOGY
EQUIVALENCY EXAMINATION

APRIL 28, 1981

DEPARTMENT OF CLINICAL LABORATORY SCIENCES
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MLT EXAM

1. The primary function of the neutrophil is to:
    - a. Make immunoglobulins
    - b. Phagocytize bacteria
    - c. Secrete heparin
    - d. Become a macrophage

2. The usual dilution for a manual white cell count using the Thoma pipette is:
    - a. 1:10
    - b. 1:20
    - c. 1:100
    - d. 1:200

3. Cytoplasmic Auer rods may be found in:
    - a. Lymphoblasts
    - b. Plasmablasts
    - c. Myeloblasts
    - d. Rubriblasts

4. Among neutrophil variants, the pince-nez or bilobed nucleus is associated with:
    - a. Alder-Reilly anomaly
    - b. Pelger-Huet anomaly
    - c. Chediak-Higashi disease
    - d. May-Hegglin anomaly

5. Cytoplasmic basophilia in blood cells is directly proportional to the:
    - a. Number of lysosomes
    - b. RNA concentration
    - c. DNA concentration
    - d. Amount of phospholipids

6. When the cells are removed from an anticoagulated blood sample, the remaining liquid is termed:
    - a. Serum
    - b. Plasma
    - c. Whole blood
    - d. Buffy coat

7. The predominant diagnostic cell in the bone marror of a patient with acute myeloid leukemia is the:
    - a. Myeloblast
    - b. Myelocyte
    - c. Metamyelocyte
    - d. Segmented neutrophil

8. A useful clue in detecting vitamin B12 or folic acic deficiency on the peripheral smear might be:
    - a. An elevated leukocyte count
    - b. An elevated lymphocyte percentage
    - c. Toxic granulation
    - d. Hypersegmented neutrophils

9. Leukopenia means:
    - a. Absence of leukocytes
    - b. Defective leukocytes
    - c. Increase in number of leukocytes
    - d. Decrease in number of leukocytes

10. The ideal white blood cell diluent for manual counts:
    - a. Destroys erythrocytes
    - b. Destroys platelets
    - c. Enlarges leukocytes
    - d. Makes granules prominent

11. Eosinophilia is most often associated with:
    - a. Acute lymphocytic leukemia
    - b. Parasitic infections
    - c. Hodgkin's disease
    - d. Infectious mononucleosis

12. A wright's-stained leukocyte shows coarse dark blue granules. It is probably a/an:
    - a. Basophil
    - b. Lymphocyte
    - c. Neutrophil
    - d. Eosinophil

13. The methanol in Wright's stain:
    - a. Adjusts the stain pH to 6.4
    - b. Gives basophilic color to chromatin
    - c. Enhances cytoplasmic eosinophilia
    - d. Fixes the cellular structures

14. The total ruled area of a Neubauer hemocytometer covers:
    - a. 1 sq. mm.
    - b. 9 sq. mm.
    - c. 10 sq. mm.
    - d. 12 sq. mm.

15. L.E. cells are altered nuclear material phagocytised by a:
    - a. Plasmacyte
    - b. Neutrophil
    - c. Lymphocyte
    - d. Monocyte

16. Dohle's inclusion bodies are generally found in:
    - a. Monoblasts
    - b. Lymphocytes
    - c. Myeloblasts
    - d. Neutrophils

17. The most common leukemia in the 1-to5-year age group is:
    - a. Acute lymphoblastic leukemia
    - b. Monocytic leukemia
    - c. Acute granulocytic leukemia
    - d. Chronic lymphocytic leukemia

18. The immediate precursor of the metamyelocyte is the:
    - a. Myeloblast
    - b. Promyelocyte
    - c. Myelocyte
    - d. Segmented neutrophil

19. The best anticoagulant for leukocyte studies is:
    - a. Sodium fluoride
    - b. Double oxalate
    - c. Potassium oxalate
    - d. EDTA

20. Toxic granulation may be associated with:
    - a. Auer rods
    - b. Barr bodies
    - c. Dohle bodies
    - d. Alder-Reilly bodies

21. An increase in both basophils and eosinophils could suggest:
    - a. Erythroblastosis fetalis
    - b. Chronic granulocytic leukemia
    - c. Infectious mononucleosis
    - d. Acute lymphocytic leukemia

22. A smear from a blood specimen with a WBC count of 16,500/mm^3 revealed seven nucleated RBC's per 100 WBCs. The corrected WBC count in mm^3 is:
    - a. 10,776
    - b. 13,098
    - c. 15,420
    - d. 17,742

23. If one draws blood to the 1.0 mark of a WBC pipette and then draws diluting fluid to the 11.0 mark, the blook dilution is:
    - a. 1:10
    - b. 1:20
    - c. 1:50
    - d. 1:100

24. A patient with a WBC count of $59,000/mm^3$, and a differential showing 98% small lymphocytes might have:
    a. L.E. disease
    b. Hodgkin's disease
    c. Chronic lymphatic leukemia
    d. Multiple myeloma

25. The peripheral blood in infectious mononucleosis characteristically will show atypical:
    a. Monocytes
    b. Plasma cells
    c. Basophils
    d. Lymphocytes

26. A Wright's-stained blood film may appear excessively pink due to:
    a. Overstaining
    b. Thin blood film
    c. Excess acidity of stain
    d. Excess alkalinity of stain

27. The term "shift to the left" inplies an increase in:
    a. Toxic granulation
    b. Young myeboid cells
    c. Adult neutrophils
    d. Mature lymphocytes

28. In order to distinguish an eosinophil from a neutrophil in a poorly stained blood smear, one should examine the:
    a. Size of the cell
    b. Shape of the nucleus
    c. Size of the granules
    d. Shape of the cell

29. A patient's blood smear and bone marrow show 85% blast cells which are positive with specific esterase, peroxidase and Sudan black stain. The cells are negative with periodic acid Schiff stain. The patient probably has:
    a. Acute granulocytic leukemia
    b. Erythroleukemia
    c. Stem cell leukemia
    d. Chronic lymphocytic leukemia

30. An adult patient has a WBC count of $14,900/mm^3$. The differential shows:

Segmented neutrophils	69%
Neutrophilic bands	19%
Lymphocytes	10%
Moncytes	1%
Eosinophils	1%

These findings suggest:
    a. Acute myelogenous leukemia
    b. Bacterial infection
    c. Infectious mononucleosis
    d. Chronic myelogenous leukemia

31. The normal fibrinogen level in mg/dl. is:
    a. 100-200
    b. 200-400
    c. 300-500
    d. 400-600

32. Capillary fragility is measured by the:
    a. Coagulation time
    b. Tourniquet test
    c. Prothrombin time
    d. Clot retraction test

33. The diluent of choice for manual platelet counts is:
    a. Hayem's solution
    b. Gower's solution
    c. Ammonium oxalate
    d. 2% acetic acid

34. A blood pressure cuff is used in determining:
    a. Lee White clotting time
    b. Duke bleeding time
    c. Ivy bleeding time
    d. Osmotic fragility

35. Hemostasis does NOT include:
    a. Platelet aggregation
    b. Procoagulant action
    c. Vascular interaction
    d. Lymphocyte activation

36. The precursor of platelets is the:
    a. Megakaryoblast
    b. Thrombocyte
    c. Megaloblast
    d. Myeloblast

37. The first stage of coagulation produces:
    a. Fibrin
    b. Thromboplastin
    c. Thrombin
    d. Prothrombin

38. The function of plasmin is to:
    a. Convert fibrinogen to fibrin
    b. Stabilize fibrin clots
    c. Lyse fibrin clots
    d. Neutralize thrombin

39. Oral anticoagulant therapy is monitored by the:
    a. Prothrombin time (PT)
    b. Activated partial thromboplastin time (APTT)
    c. Bleeding Time
    d. Fibrinogen assay

40. The reagents used in the prothrombin time are:
    a. Fibrinogen and thromboplastin
    b. Fibrinogen and calcium
    c. Thromboplastin and calcium
    d. Platelet substance and thromboplastin

41. Barium sulfate added to plasma will adsorb:
    a. Factor VIII only
    b. Factor VIII and IX
    c. Factor VIII and prothrombin
    d. Factor IX and prothrombin

42. The vitamin necessary for prothrombin synthesis is:
    a. A
    b. B_{12}
    c. C
    d. K

43. Poor clot retraction suggest a deficiency of:
    a. Platelets
    b. Factor XII
    c. Plasmin
    d. Fibrinolysin

44. An anticoagulant which neutralizes thrombin is:
    a. Oxalate
    b. Ethylenediamine tetra-acetate (EDTA)
    c. Citrate
    d. Heparin

45. The coagulation stage to which fibrinolysin belongs is:
    a. I
    b. II
    c. III
    d. IV

46. A reagent used for the partial thromboplastin time is:
    a. Cephalin
    b. Tissue thromboplastin
    c. Heparin
    d. Thrombin

47. Fibrin stabilization requires adequate factor:
    a. X
    b. XI
    c. XII
    d. XIII

48. Activation of factor X via the extrinsic coagulation pathway requires factor:
    a. VII
    b. VIII
    c. IX
    d. XII

49. An activity NOT characteristic of platelets is:
    a. Plasma thromboplastin generation
    b. Initial hemostatic plug formation
    c. Clot retraction
    d. Fibrinolysis

50. The platelet count of blood filtered through a glass bead column as compared to that of an unfiltered control in a platelet adhesiveness test with normal results is:
    a. Considerably lower
    b. Higher
    c. Unchanged
    d. Slightly lower

51. A blood smear from an EDTA tube reveals an average of 5-10 platelets per oil immersion field. The best platelet estimate per ul would be about:
    a. 30,000
    b. 80,000
    c. 180,000
    d. 620,000

52. Correction studies for a factor IX deficiency would show:
    a. PT corrected by aged serum
    b. PTT corrected by aged serum
    c. PT corrected by $BaSO_4$ adsorbed plasma
    d. PTT corrected by $BaSO_4$ adsorbed plasma

53. Prolonged PT and PTT times suggest a deficiency of factors:
    a. II and VIII
    b. V and X
    c. VIII and IX
    d. XI and XIII

54. A patient with von Willebrand's disease is likely to have an abnormal:
    a. Lee-White clotting time
    b. Fibrinogen level
    c. Bleeding time
    d. PT

55. A thrombocytopenic patient might have a:
    a. Normal APTT and delayed Ivy bleeding time
    b. Prolonged PT and normal Lee-White
    c. Prolonged thrombin time and normal Ivy bleeding time
    d. Normal Ivy bleeding time and prolonged Lee-White

56. The accuracy of the APTT can be best ensured by:
    a. Prolonged centrifugation
    b. Immediate performance of the test
    c. Use of pooled normal plasma as a control
    d. Storage of the patient's plasma at 37°C until the test is run.

57. A test of NO value in evaluating a patient with defective platelets is the:
    a. Bleeding time
    b. Clot retraction
    c. PT
    d. Prothrombin consumption test

58. A patient for a coagulation workup had a bleeding time of 4 minutes, a PT of 12 seconds and an APTT of 33 seconds. The platelet count is 50,000. You should:
    - a. Repeat all the test
    - b. Report the results
    - c. Repeat the PT and PTT
    - d. Check the smear and repeat the platelet count

59. You have just called a stat APTT to the physician. You touch the fibrometer block and notice that it feels cold when you return to your work area. The block's temperature is 16°C. The first thing to do is:
    - a. Nothing because there is no problem
    - b. Correct the heating block temperature
    - c. Repeat the test and report the new result
    - d. Call the physician

60. A technician diluted whole blood 1:100 with ammonium oxalate in a Unopette. He counted 350 platelets in one square mm. of a Neubauer counting chamber and reported a count of 35,000/mm^3. The conclusion you would draw is:
    - a. Report the count
    - b. Repeat the count
    - c. Multiply the count by 10
    - d. Divide the count by 10

61. Schistocytes are:
    - a. Hypochromic RBC
    - b. RBC fragments
    - c. Multinucleated RBC
    - d. Macrocytic RBC

62. An anemia caused by an inherited RBC defect found primarily in people of Mediterranean ancestry is:
    - a. Sicle cell anemia
    - b. Aplastic anemia
    - c. Thalassemia major
    - d. Pernicious anemia

63. The hemoglobin usually found in the fetal circulation is:
    - a. A
    - b. C
    - c. D
    - d. F

64. The abnormality in hemoglobinopathies resides in the:
    - a. Globin chain
    - b. Iron portion
    - c. Heme molecule
    - d. Porphyrin molecule

65. A cell which has a nucleus is the:
    - a. Reticulocyte
    - b. Normoblast
    - c. Polychromatophilic erythrocyte
    - d. Erythrocyte with basophilic stippling

66. Hemoglobin electrophoresis patterns at pH 8.6 show that:
   a. Hgb S moves faster than hgb A
   b. Hgb C moves faster than hgb A
   c. Hgb A moves more slowly than hgbC or hgb S
   d. Hgb S moves faster than hgb C but more slowly than hgb A

67. The most accurate term for red blood cell production is:
   a. Hemopoiesis
   b. Erythropoiesis
   c. Erythrokinetics
   d. Hemokinetics

68. Normal erythrocyte formation after birth is confined to the:
   a. Liver
   b. Spleen
   c. Bone marrow
   d. Reticuloendothelial system

69. Nucleoli are observed in:
   a. Rubricytes
   b. Reticulocytes
   c. Polychromatophilic erythrocytes
   d. Rubriblasts

70. The globin chains in normal adult hemoglobin are composed of:
   a. two alpha and two gamma
   b. two alpha and two beta
   c. two alpha and two delta
   d. two beta and two gamma

71. The erythrocyte normal life span in days is:
   a. 30
   b. [illegible]
   c. 120
   d. 150

72. The hemoglobin that moves closest to the anode on cellulose acetate electrophoresis is:
   a. A
   b. C
   c. F
   d. S

73. Erythrocyte color in Wright's stain which is too acid is:
   a. Pale blue
   b. Grey
   c. Purple
   d. Deep red

74. Erythrocytes containing Pappenheimer bodies are:
   a. Drepanocytes
   b. Leptocytes
   c. Siderocytes
   d. Echinocytes

75. The hemoglobin electrophoresis pattern in sickle cell trait is:
a. AA
b. SS
c. AS
d. AF

76. Supravital staining of reticulocytes requires:
a. Crystal violet
b. Methyl red
c. Wright's stain
d. New Methylene blue

77. Hemoglobin concentrations are:
a. Higher in women than in men
b. Lower in newborns than in adults
c. Higher in the mountains than at the seashore
d. Lower in the mountains than at the seashore

78. The direct Coombs test is usually positive in:
a. Sickle cell anemia
b. Thalassemia major
c. Pernicious anemia
d. Autoimmune hemolytic anemia

79. Cellular maturity in nucleated erythrocytes is associated with:
a. Blue cytoplasmic color
b. Numerous nucleoli
c. Clumped chromatin
d. Large nuclear size

80. A reticulocyte count of 12.5% correlates with a peripheral smear finding of:
a. Spherocytosis
b. Burr cells
c. Polychromasia
d. Aplasia

81. A patient with a hematocrit of 42% might be expected to have a hgb concentration of:
a. 13.5 g./dl
b. 14.0 g./dl
c. 14.5 g./dl
d. 15.0 g./dl

82. A blood smear shows predominantly microcytic hypochromic erythrocytes with decreased serum iron. Iron therapy results in an increased reticulocyte count. The patient probably has:
a. Sickle cell anemia
b. Hereditary spherocytosis
c. Aplastic anemia
d. Iron deficiency anemia

83. A blood smear reveals large pale erythrocytes with many bizarre shapes. The RBC morphology would be:
a. Marked poikilocytosis and hypochromic macrocytes
b. Marked anisocytosis and spherocytic macrocytes
c. Marked poikilocytosis and hyperchromic microcytes
d. Marked anisocytosis and hyperchromic microcytes

84. A red count on anemic blood is done by drawing the blood to the 0.5 mark in a RBC pipette and then diluting to the 101 mark. The total number of cells counted in 5 RBC squares is 145. The RBC count in cu. mm. is:
    a. 145,000
    b. 290,000
    c. 1,450,000
    d. 2,900,000

85. A test which will help in the diagnosis of a patient with many sickled and target cells is:
    a. Hemoglobin electrophoresis
    b. Iron stain
    c. Hematocrit
    d. Reticulocyte count

86. A 25 year-old male had a RBC count of 4.5 mil./cu.mm., a hgb of 14.0 g/dl., and hct of 43%. These findings are typical of:
    a. Hemolytic anemia
    b. Polycythemia vera
    c. A normal state
    d. Excess bleeding

87. Hypochromic normocytic red cells on a smear appear to be:
    a. Normal in size and in hemoglobin concentration
    b. Larger than normal and deficient in hemoglobin
    c. Smaller than normal and deficient in hemoglobin
    d. Normal in size but deficient in hemoglobin

88. The following data were obtained:

	Hgb	RBC count in mil./mm^3	Hct
Patient A	15.0	4.5	46
Patient B	11.2	3.4	33
Patient C	10.1	3.1	31
Patient D	9.1	4.1	29

Which patient results would you recheck?
    a. A
    b. B
    c. C
    d. D

89. Sam Johnson has the following lab results: hgb=21.1g/dl; WBC=16,000/mm^3; RBC=6.7 mil./mm3; hct = 63%; platelets = 850,000/cu. mm. A disease that fits this pattern is:
    a. Congenital ovalocytosis
    b. Polycythemia vera
    c. Pernicious anemia
    d. Congenital spherocytosis

90. A patient has the following results: hgb = 5.4 g/dl; RBC count of 3.0 mil./mm3, and hct of 20%. The most likely disorder is:
    a. Vitamin B_{12} deficiency
    b. Hereditary spherocytosis
    c. Hemoglobin C disease
    d. Iron deficiency

91. An anticoagulant which chelates calcium ions is:
   a. Heparin
   b. Sodium citrate
   c. Ammonium and potassium oxalate
   d. EDTA

92. The vein usually chosen for venipuncture is the:
   a. Median basilic
   b. Subclavian
   c. Median cephalic
   d. Axillary

93. The test which should be drawn first from a capillary specimen is the:
   a. Red cell count
   b. Platelet count
   c. Hemoglobin
   d. Differential

94. An anticoagulant which helps prevent rapid deterioration of unstable clotting factors is:
   a. EDTA
   b. Sodium fluoride
   c. Heparin
   d. Sodium citrate

95. After applying 70% alcohol for a venipuncture one should:
   a. Allow the alcohol to dry before needle insertion
   b. Verify the vein location by palpation
   c. Insert the needle immediately after applying the alcohol
   d. Dry the alcohol with gauze before inserting the needle

96. The anticoagulant in a vacuum blood collection tube with a lavender stopper is:
   a. Heparin
   b. EDTA
   c. Sodium oxalate
   d. Sodium citrate

97. OSHA legislation affecting the hematology laboratory concerns:
   a. Safe job practice
   b. External quality control
   c. Fair labor practice
   d. Internal quality control

98. You can best avoid infecting yourself and others during specimen collection by:
   a. Washing your hands before and after venipuncture rounds
   b. Wiping your fingertips with alcohol after every venipuncture
   c. Washing your hands with soap and water after each venipuncture
   d. Autoclaving your lab coat

99. The Coulter S measures directly the:
   a. Hematocrit
   b. MCV
   c. MCH
   d. MCHC

100. Oil is used in microscopy to:
    - a. Reduce light diffraction
    - b. Decrease resolving power
    - c. Adjust the numerical aperture
    - d. Increase focal distance

101. A principle NOT utilized in automated coagulation instruments is:
    - a. Conductivity
    - b. Optical density
    - c. Viscosity
    - d. Refractive index

102. A differential count from a Wright's-stained smear of cerebrospinal fluid is reported as the number of:
    - a. Polymorphonuclear and mononuclear cells per 100 WBC
    - b. Neutrophils per 100 WBC
    - c. Lymphocytes per 100 WBC
    - d. Polymorphonuclear cells, lymphocytes and monocytes

103. A hematologic standard which can be used in a daily quality control program is:
    - a. Stabilized WBC suspension
    - b. Certified cyanmethemoglobin
    - c. Latex particles
    - d. Fixed nucleated cell suspension

104. A response NOT related to the other three is:
    - a. Versene EDTA
    - b. Ammonium potassium oxalate
    - c. Sequestrene
    - d. Dipotassium ethylenediamine tetra-acetate

105. The per cent of specimens included in ± two standard deviations of the mean of 200 hemoglobin determinations would be:
    - a. 68.0%
    - b. 86.0%
    - c. 95.0%
    - d. 99.7%

106. A sign of a hypersensitivity reaction is:
    - a. Eosinophilia in nasal discharge
    - b. Eosinopenia in pleural fluid
    - c. Neutrophilia in nasal discharge
    - d. Neutrophilia in pleural fluid

107. Liquid EDTA is preferred to powdered EDTA because liquid EDTA is:
    - a. Less susceptible to contamination
    - b. Less expensive
    - c. More stable
    - d. Faster acting

108. A systematic error in hematologic counting procedures would be caused by:
    - a. Incorrect pH of diluent
    - b. Fibrin clots in specimens
    - c. Incomplete sampling of specimens
    - d. Improper mixing of specimens

109. Gastric secretory activity is usually measured by the patient's level of:
   a. Hydrolyzed casein
   b. Mucuous secretion
   c. HCl
   d. Intrinsic factor

110. A technician was able to focus a specimen under low power but could not do so under oil immersion. The problem is probably NOT:
   a. A dirty oil immersion objective
   b. Slide inversion
   c. The level of the substage condenser
   d. Height of the coarse adjustment knob

111. A 60 year-old man with joint pain has joint fluid removed by a physician. The technician notices crystals on microscopic examination. They are probably:
   a. Sulfathiazole
   b. Uric acid
   c. Calcium oxalate
   d. Tyrosine

112. A falsely over-diluted capillary specimen may be caused by:
   a. Squeezing the finger excessively
   b. Puncturing the skin too deeply
   c. Collecting ear lobe blood
   d. Failing to wipe capillary pipettes

113. The greatest potential electrical hazard in a hematology laboratory is a/an:
   a. "tripped' circuit breaker
   b. Instrument which aspirates liquids
   c. Improperly grounded instrument
   d. Blown fuse

114. In performing an undiluted count of CSF, 87 WBCs are counted in the entire ruled area on one side of the counting chamber. The reported results in cells per cubic millimeter is:
   a. 78
   b. 87
   c. 96
   d. 870

115. A spinal fluid specimen has 3 WBC/ul with a predominance of lymphocytes. The state which best fits this description is:
   a. Findings typical of viral, fungal, or tubercle meningitis
   b. Inflammatory disease of the central nervous system
   c. Normal characteristics
   d. Bloody or traumatic tap

116. A reliable centrifuged microhematocrit determination could be obtained by:
   a. Collecting 1 ml. of venous blood in a 5 ml. EDTA-anticoagulated vacutainer tube
   b. Performing a finger-stick and squeezing the finger to fill the capillary tube with blood.
   c. Omitting the buffy coat from the measurement of the cell column height
   d. Centrifuging the capillary tubes until you think the cells are well-packed.

117. Automated counts are more accurate than manual counts because:
    a. A larger number of cells is counted
    b. A larger dilution of blood is used
    c. Nucleated cells are excluded from counts
    d. A better diluent is used

118. A 35.5 x 10^3/mm white count comes before a 5.2 x 10^3 /mm count on the Coulter S. One should:
    a. Repeat both results
    b. Repeat the first count
    c. Repeat the second count
    d. Report both counts

119. A patient is receiving an intravenous solution of 5% dextrose and water in the left hand and a blood transfusion in antecubital vein of the right arm. It is necessary for you to obtain a venous blood sample for a complete blood count. The best course of action is to:
    a. Disconnect the intravenous in the left hand and draw blood through the IV needle
    b. Disconnect the tranfusion tubing and draw blood from the transfusion needle
    c. Draw blood from the antecubital vein of the left arm
    d. Draw blood from a right wrist or hand vein

120. When you are confronted with a fire emergency in which a hematology laboratory instrument is burning, the FIRST thing that you should do is:
    a. Use a Class A extinguisher to put out the fire
    b. Use a Class B extinguisher to put out the fire
    c. Alert nearby people of the fire
    d. Alert the hospital fire brigade

MPL 77.4

D2

REVISED MT EXAMINATION

	MPI					GRID REFERENCE		TAXONOMIC LEVEL
ITEM	1	2	3	4	APL			
1	0	X	0	0	1.0	WBC	1a.	RECALL
2	2	1	2	X	.3	WBC	3h.	RECALL
3	X	1	1	0	.5	WBC	6h.	RECALL
4	0	0	2	X	.5	WBC	6g.	RECALL
5	1	X	0	0	.7	WBC	7c.	RECALL
6	1	0	X	0	.7	WBC	7f.	RECALL
7	2	1	X	0	.4	WBC	3e.	RECALL
8	1	0	1	X	.5	WBC	6c.	RECALL
9	0	1	X	2	.4	WBC	5e.	RECALL
10	1	X	0	1	.5	WBC	2f.	RECALL
11	0	0	2	X	.5	WBC	6g.	RECALL
12	1	0	X	0	.7	WBC	21.	INTERPRETATION
13	2	1	0	X	.4	WBC	6c.	INTERPRETATION
14	1	0	X	0	.7	WBC	7e.	INTERPRETATION
15	0	X	1	0	.7	WBC	7p.	INTERPRETATION
16	0	X	0	0	1.0	WBC	1b.	INTERPRETATION
17	1	X	0	1	.5	WBC	2i.	INTERPRETATION
18	X	1	0	0	.7	WBC	5g.	INTERPRETATION
19	1	0	X	2	.4	WBC	6b.	INTERPRETATION
20	0	0	X	1	.7	WBC	7n.	INTERPRETATION
21	1	2	X	1	.3	WBC	1c.	INTERPRETATION
22	X	1	1	0	.5	WBC	7h.	INTERPRETATION
23	X	0	1	0	.7	WBC	7r.	PROBLEM SOLVING
24	1	1	X	0	.5	WBC	6g.	PROBLEM SOLVING
25	X	2	1	0	.4	WBC	4d.	PROBLEM SOLVING
26	2	X	1	0	.4	WBC	5p.	PROBLEM SOLVING

MPI

ITEM	1	2	3	4	ALP	GRID REFERENCE		TAXONOMIC LEVEL
27	X	1	0	1	.5	WBC	6d.	PROBLEM SOLVING
28	0	1	X	0	.7	WBC	6e.	PROBLEM SOLVING
29	0	X	2	1	.4	WBC	7u.	PROBLEM SOLVING
30	0	0	X	0	1.0	WBC	7s.	PROBLEM SOLVING
31	0	0	0	X	1.0	COAGULATION	Ib.3	RECALL
32	0	0	X	0	1.0	COAGULATION	II c.2	RECALL
33	1	0	X	0	.7	COAGULATION	III d.1	RECALL
34	X	2	0	0	.5	COAGULATION	II c.1	RECALL
35	1	1	X	0	.5	COAGULATION	I b.a.	RECALL
36	0	0	X	1	.7	COAGULATION	I b.4	RECALL
37	X	0	1	0	.7	COAGULATION	II b.2	RECALL
38	0	X	1	0	.7	COAGULATION	II c.1	RECALL
39	X	0	0	0	1.0	COAGULATION	II c.2	RECALL
40	0	0	0	X	1.0	COAGULATION	III b.1	RECALL
41	X	1	1	1	.4	COAGULATION	III c.1	RECALL
42	2	0	X	1	.4	COAGULATION	I b.3	INTERPRETATION
43	X	0	0	1	.4	COAGULATION	I b.3	INTERPRETATION
44	0	1	X	0	.7	COAGULATION	II b.1	INTERPRETATION
45	0	X	0	0	1.0	COAGULATION	II b.2	INTERPRETATION
46	0	0	X	1	.7	COAGULATION	II c.1	INTERPRETATION
47	1	X	1	1	.4	COAGULATION	II c.10	INTERPRETATION
48	X	1	0	0	.7	COAGULATION	II d.	INTERPRETATION
49	2	0	0	X	.5	COAGULATION	III a	INTERPRETATION
50	0	X	0	0	1.0	COAGULATION	III d.1	INTERPRETATION
51	X	2	1	0	.4	COAGULATION	III e	INTERPRETATION
52	1	1	X	0	.5	COAGULATION	II c.4	INTERPRETATION

	MPI					GRID REFERENCE	TAXONOMIC LEVEL
ITEM	1	2	3	4	ALP		
53	0	2	0	X	.5	COAGULATION II d	INTERPRETATION
54	1	0	2	X	.4	COAGULATION II d	PROBLEM SOLVING
55	X	1	0	0	.7	COAGULATION III d.1	PROBLEM SOLVING
56	0	X	0	1	.7	COAGULATION II b.1	PROBLEM SOLVING
57	X	0	0	1	.7	COAGULATION III c.2	PROBLEM SOLVING
58	1	1	X	1	.4	COAGULATION III d.2	PROBLEM SOLVING
59	0	0	X	1	.7	COAGULATION III c.1	PROBLEM SOLVING
60	0	1	X	1	.5	COAGULATION III c.1	PROBLEM SOLVING
61	0	1	X	0	.7	RBC I	RECALL
62	1	X	0	0	.7	RBC II c	RECALL
63	0	X	1	1	.5	RBC III a.9	RECALL
64	1	X	1	0	.5	RBC III b.1	RECALL
65	1	1	0	X	.5	RBC III b.3	RECALL
66	X	0	1	0	.7	RBC III b.1	RECALL-
67	1	1	X	0	.5	RBC III c.1	RECALL
68	0	X	0	0	1.0	RBC III d	RECALL
69	0	0	X	0	1.0	RBC II c	RECALL
70	0	0	0	X	1.0	RBC III c.1	RECALL
71	0	0	X	0	1.0	RBC III a.14	RECALL
72	1	X	2	0	.4	RBC IV b.1	INTERPRETATION
73	0	0	2	X	.5	RBC IV e.1	INTERPRETATION
74	1	X	1	0	.5	RBC IV a.	INTERPRETATION
75	X	1	0	0	.7	RBC IV a.1	INTERPRETATION
76	1	0	X	0	.7	RBC IV d.2	INTERPRETATION
77	1	2	0	X	.4	RBC IV d.2	INTERPRETATION
78	X	0	0	1	.7	RBC III a.3	INTERPRETATION

	MPI					GRID REFERENCE	TAXONOMIC LEVEL
ITEM	1	2	3	4	ALP		
79	1	X	2	0	.4	RBC I	INTERPRETATION
80	1	0	X	1	.5	RBC III a.16	INTERPRETATION
81	1	X	1	0	.5	RBC IV b.1	INTERPRETATION
82	0	1	1	X	.5	RBC III e.	INTERPRETATION
83	1	X	0	2	.4	RBC IV c.1 (a)	INTERPRETATION
84	0	1	0	X	.7	RBC IV a.1	PROBLEM SOLVING
85	0	X	0	1	.7	RBC III d.	PROBLEM SOLVING
86	X	1	0	1	.5	RBC IV d.1	PROBLEM SOLVING
87	1	X	0	0	.7	RBC III a.3	PROBLEM SOLVING
88	X	1	1	1	.4	RBC IV c.b	PROBLEM SOLVING
89	0	2	0	X	.5	RBC IV d.	PROBLEM SOLVING
90	0	1 =	X	0 =	.7	RBC III e.	PROBLEM SOLVING
91	0	0	X	1	.7	QUAL. CONT. A g.	RECALL
92	0	0	X	0	1.0	Instru. B-1 a.	RECALL
93	0	X	0	0	1.0	INSTRU. B-1 a.	RECALL
94	0	0	X	1	.7	MISC. E-2	RECALL
95	0	0	X	0	1.0	MISC. A-2	RECALL
96	0	0	1	X	.7	MISC. B-1	RECALL
97	0	0	X	1	.7	INSTRU. A-2	RECALL
98	1	X	0	0	.7	INSTRU. B-3	RECALL
99	0	X	1	0	.7	QUAL. CONT. C-2	RECALL
100	0	X	0	1	.7	MISC. C-3	RECALL
101	0	X	0	0	1.0	MISC. B-2	RECALL
102	X	0	0	0	1.0	MISC. B-1	INTERPRETATION
103	1	0	X	1	.5	QUAL. CONT. A h.	INTERPRETATION
104	1	0	1	X	.5	MISC. D-6	INTERPRETATION

	MPI					GRID REFERENCE	TAXONOMIC LEVEL
ITEM	1	2	3	4	ALP		
105	1	0	0	X	.7	QUAL. CONT. C-1	INTERPRETATION
106	0	1	X	0	.7	MISC. E-2	INTERPRETATION
107	0	0	1	X	.7	QUAL. CONT. D-1a	INTERPRETATION
108	0	0	0	X	1.0	QUAL. CONT. C-2	INTERPRETATION
109	X	1	0	0	.7	QUAL. CONT. A-1	INTERPRETATION
110	0	1	0	X	.7	MISC. D-1	INTERPRETATION
111	0	X	0	0	1.0	MISC. E-2	INTERPRETATION
112	1	X	0	0	.7	INSTRU. B-1a	INTERPRETATION
113	X	0	1	0	.7	INSTRU. B-1a	PROBLEM SOLVING
114	0	1	X	0	.7	INSTRU. B-1a	PROBLEM SOLVING
115	1	X	1	0	.5	INSTRU. B-1b	PROBLEM SOLVING
116	X	1	0	0	.7	MISC. E-2	PROBLEM SOLVING
117	0	0	1	X	.7	MISC. B-1	PROBLEM SOLVING
118	X	1	2	0	.4	QUAL. CONT. C-2	PROBLEM SOLVING
119	1	0	X	0	.7	QUAL. CONT. C-1	PROBLEM SOLVING
120	0	1	0	X	.7	QUAL. CONT. C	PROBLEM SOLVING

MPL 77.4

D2

REVISED MT EXAMINATION

ITEM	MPI 1	2	3	4	APL	GRID REFERENCE		TAXONOMIC LEVEL
1	0	X	0	0	1.0	WBC	1a.	RECALL
2	2	1	2	X	.3	WBC	3h.	RECALL
3	X	1	1	0	.5	WBC	6h.	RECALL
4	0	0	2	X	.5	WBC	6g.	RECALL
5	1	X	0	0	.7	WBC	7c.	RECALL
6	1	0	X	0	.7	WBC	7f.	RECALL
7	2	1	X	0	.4	WBC	3e.	RECALL
8	1	0	1	X	.5	WBC	6c.	RECALL
9	0	1	X	2	.4	WBC	5e.	RECALL
10	1	X	0	1	.5	WBC	2f.	RECALL
11	0	0	2	X	.5	WBC	6g.	RECALL
12	1	0	X	0	.7	WBC	21.	INTERPRETATION
13	2	1	0	X	.4	WBC	6c.	INTERPRETATION
14	1	0	X	0	.7	WBC	7e.	INTERPRETATION
15	0	X	1	0	.7	WBC	7p.	INTERPRETATION
16	0	X	0	0	1.0	WBC	1b.	INTERPRETATION
17	1	X	0	1	.5	WBC	2i.	INTERPRETATION
18	X	1	0	0	.7	WBC	5g.	INTERPRETATION
19	1	0	X	2	.4	WBC	6b.	INTERPRETATION
20	0	0	X	1	.7	WBC	7n.	INTERPRETATION
21	1	2	X	1	.3	WBC	1c.	INTERPRETATION
22	X	1	1	0	.5	WBC	7h.	INTERPRETATION
23	X	0	1	0	.7	WBC	7r.	PROBLEM SOLVING
24	1	1	X	0	.5	WBC	6g.	PROBLEM SOLVING
25	X	2	1	0	.4	WBC	4d.	PROBLEM SOLVING
26	2	X	1	0	.4	WBC	5p.	PROBLEM SOLVING

MPI

ITEM	1	2	3	4	ALP	GRID REFERENCE		TAXONOMIC LEVEL
27	X	1	0	1	.5	WBC	6d.	PROBLEM SOLVING
28	0	1	X	0	.7	WBC	6e.	PROBLEM SOLVING
29	0	X	2	1	.4	WBC	7u.	PROBLEM SOLVING
30	0	0	X	0	1.0	WBC	7s.	PROBLEM SOLVING
31	0	0	0	X	1.0	COAGULATION Ib.3		RECALL
32	0	0	X	0	1.0	COAGULATION II c.2		RECALL
33	1	0	X	0	.7	COAGULATION III d.1		RECALL
34	X	2	0	0	.5	COAGULATION II c.1		RECALL
35	1	1	X	0	.5	COAGULATION I b.a.		RECALL
36	0	0	X	1	.7	COAGULATION I b.4		RECALL
37	X	0	1	0	.7	COAGULATION II b.2		RECALL
38	0	X	1	0	.7	COAGULATION II c.1		RECALL
39	X	0	0	0	1.0	COAGULATION II c.2		RECALL
40	0	0	0	X	1.0	COAGULATION III b.1		RECALL
41	X	1	1	1	.4	COAGULATION III c.1		RECALL
42	2	0	X	1	.4	COAGULATION I b.3		INTERPRETATION
43	X	0	0	1	.4	COAGULATION I b.3		INTERPRETATION
44	0	1	X	0	.7	COAGULATION II b.1		INTERPRETATION
45	0	X	0	0	1.0	COAGULATION II b.2		INTERPRETATION
46	0	0	X	1	.7	COAGULATION II c.1		INTERPRETATION
47	1	X	1	1	.4	COAGULATION II c.10		INTERPRETATION
48	X	1	0	0	.7	COAGULATION II d.		INTERPRETATION
49	2	0	0	X	.5	COAGULATION III a		INTERPRETATION
50	0	X	0	0	1.0	COAGULATION III d.1		INTERPRETATION
51	X	2	1	0	.4	COAGULATION III e		INTERPRETATION
52	1	1	X	0	.5	COAGULATION II c.4		INTERPRETATION

	MPI					GRID REFERENCE	TAXONOMIC LEVEL
ITEM	1	2	3	4	ALP		
53	0	2	0	X	.5	COAGULATION II d	INTERPRETATION
54	1	0	2	X	.4	COAGULATION II d	PROBLEM SOLVING
55	X	1	0	0	.7	COAGULATION III d.1	PROBLEM SOLVING
56	0	X	0	1	.7	COAGULATION II b.1	PROBLEM SOLVING
57	X	0	0	1	.7	COAGULATION III c.2	PROBLEM SOLVING
58	1	1	X	1	.4	COAGULATION III d.2	PROBLEM SOLVING
59	0	0	X	1	.7	COAGULATION III c.1	PROBLEM SOLVING
60	0	1	X	1	.5	COAGULATION III c.1	PROBLEM SOLVING
61	0	1	X	0	.7	RBC I	RECALL
62	1	X	0	0	.7	RBC II c	RECALL
63	0	X	1	1	.5	RBC III a.9	RECALL
64	1	X	1	0	.5	RBC III b.1	RECALL
65	1	1	0	X	.5	RBC III b.3	RECALL
66	X	0	1	0	.7	RBC III b.1	RECALL
67	1	1	X	0	.5	RBC III c.1	RECALL
68	0	X	0	0	1.0	RBC III d	RECALL
69	0	0	X	0	1.0	RBC II c	RECALL
70	0	0	0	X	1.0	RBC III c.1	RECALL
71	0	0	X	0	1.0	RBC III a.14	RECALL
72	1	X	2	0	.4	RBC IV b.1	INTERPRETATION
73	0	0	2	X	.5	RBC IV e.1	INTERPRETATION
74	1	X	1	0	.5	RBC IV a.	INTERPRETATION
75	X	1	0	0	.7	RBC IV a.1	INTERPRETATION
76	1	0	X	0	.7	RBC IV d.2	INTERPRETATION
77	1	2	0	X	.4	RBC IV d.2	INTERPRETATION
78	X	0	0	1	.7	RBC III a.3	INTERPRETATION

	MPI					GRID REFERENCE	TAXONOMIC LEVEL
ITEM	1	2	3	4	ALP		
79	1	X	2	0	.4	RBC I	INTERPRETATION
80	1	0	X	1	.5	RBC III a.16	INTERPRETATION
81	1	X	1	0	.5	RBC IV b.1	INTERPRETATION
82	0	1	1	X	.5	RBC III e.	INTERPRETATION
83	1	X	0	2	.4	RBC IV c.1 (a)	INTERPRETATION
84	0	1	0	X	.7	RBC IV a.1	PROBLEM SOLVING
85	0	X	0	1	.7	RBC III d.	PROBLEM SOLVING
86	X	1	0	1	.5	RBC IV d.1	PROBLEM SOLVING
87	1	X	0	0	.7	RBC III a.3	PROBLEM SOLVING
88	X	1	1	1	.4	RBC IV c.b	PROBLEM SOLVING
89	0	2	0	X	.5	RBC IV d.	PROBLEM SOLVING
90	0	1	X	0	.7	RBC III e.	PROBLEM SOLVING
91	0	0	X	1	.7	QUAL. CONT. A g.	RECALL
92	0	0	X	0	1.0	Instru. B-1 a.	RECALL
93	0	X	0	0	1.0	INSTRU. B-1 a.	RECALL
94	0	0	X	1	.7	MISC. E-2	RECALL
95	0	0	X	0	1.0	MISC. A-2	RECALL
96	0	0	1	X	.7	MISC. B-1	RECALL
97	0	0	X	1	.7	INSTRU. A-2	RECALL
98	1	X	0	0	.7	INSTRU. B-3	RECALL
99	0	X	1	0	.7	QUAL. CONT. C-2	RECALL
100	0	X	0	1	.7	MISC. C-3	RECALL
101	0	X	0	0	1.0	MISC. B-2	RECALL
102	X	0	0	0	1.0	MISC. B-1	INTERPRETATION
103	1	0	X	1	.5	QUAL. CONT. A h.	INTERPRETATION
104	1	0	1	X	.5	MISC. D-6	INTERPRETATION

	MPI					GRID REFERENCE	TAXONOMIC LEVEL
ITEM	1	2	3	4	ALP		
105	1	0	0	X	.7	QUAL. CONT. C-1	INTERPRETATION
106	0	1	X	0	.7	MISC. E-2	INTERPRETATION
107	0	0	1	X	.7	QUAL. CONT. D-1a	INTERPRETATION
108	0	0	0	X	1.0	QUAL. CONT. C-2	INTERPRETATION
109	X	1	0	0	.7	QUAL. CONT. A-1	INTERPRETATION
110	0	1	0	X	.7	MISC. D-1	INTERPRETATION
111	0	X	0	0	1.0	MISC. E-2	INTERPRETATION
112	1	X	0	0	.7	INSTRU. B-1a	INTERPRETATION
113	X	0	1	0	.7	INSTRU. B-1a	PROBLEM SOLVING
114	0	1	X	0	.7	INSTRU. B-1a	PROBLEM SOLVING
115	1	X	1	0	.5	INSTRU. B-1b	PROBLEM SOLVING
116	X	1	0	0	.7	MISC. E-2	PROBLEM SOLVING
117	0	0	1	X	.7	MISC. B-1	PROBLEM SOLVING
118	X	1	2	0	.4	QUAL. CONT. C-2	PROBLEM SOLVING
119	1	0	X	0	.7	QUAL. CONT. C-1	PROBLEM SOLVING
120	0	1	0	X	.7	QUAL. CONT. C	PROBLEM SOLVING

E1

PROCTOR'S MANUAL

HEMATOLOGY
EQUIVALENCY EXAMINATION

APRIL 28, 1981

DEPARTMENT OF CLINICAL LABORATORY SCIENCES
SCHOOL OF ALLIED HEALTH PROFESSIONS
COLLEGE OF MEDICINE & DENTISTRY OF N.J.
100 BERGEN STREET
NEWARK, NEW JERSEY 07103
(201) 456-4769

MANUAL OF INSTRUCTIONS

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I. INTRODUCTION

This manual is designed to aid proctors in administering this examination. It provides general information such as arrangements and procedures needed before, during, and after the test as well as detailed instructions to follow on the day of the examination. READ THIS MANUAL CAREFULLY PRIOR TO THE EXAMINATION DATE AND BE SURE TO HAVE IT AVAILABLE ON THE DAY OF EXAMINATION.

If you have questions not covered in this manual, if you are not certain about something, or if an unforeseen event occurs, call the following immediately by collect phone call charged to account number 139524:

Hannah Zane
Medical Technology Program Director
CMDNJ/SAHP
100 Bergen Street
Newark, N.J. 07103
Telephone: 201-456-4769

* * * * * * * * * * * * * * * * * * *

II. GENERAL INSTRUCTIONS

A. DUTIES AND RESPONSIBILITIES OF THE CHIEF PROCTOR

The Chief Proctor is responsible for conducting the examination in strict compliance with the regulations in this manual, for maintaining the complete security of the examination material at all times, and returning all answer sheets, test books, and other test materials to the CMDNJ/SAHP official whose address is on the return shipping material.

- Personally receive and promptly act on all communications received from the CMDNJ/SAHP concerning this examination.
- Receive, check, and be fully responsible for the security of all test materials.
- Plan admission and dismissal of examinees to ensure test security, minimum disturbance, and adherence to schedules.
- Recruit a sufficient number of competent assistants (one assistant per each 20 examinees) and brief them in their duties prior to the test date.
- Become thoroughly familiar with the Proctor's Manual, particularly with regard to timing and security. Call the CMDNJ/SAHP official about any irregularities.
- Collect, account for, and return all test materials. Complete and return the Proctor's Report of Test Administration. Be sure to note any irregularities on the Report.

B. ARRANGEMENT FOR TESTING FACILITIES

(1.) Testing Room - Ideally, the testing room should have sufficient seats to allow seating of examinees in alternate seats of alternate rows. If this is not possible, seat examinees in alternate seats in every row. The proctors should have inimpeded access to every examinee. Every testing room should have a wall clock that the examinees can see. If the testing room does not have a wall clock visible to the examinees, the Chief Proctor should post the time remaining (at appropriate half-hour intervals) for the test.

(2.) Pencils - Examinees are instructed to bring to the examination two ordinary soft lead pencils. It is advisable to have on hand a small supply of No. 2 lead pencils (for forgetful examinees) and if possible, a pencil sharpener.

C. RECEIPT OF TEST MATERIALS

First Class Mailing (Administrative Information and Test Materials): Sent from the CMDNJ/SAHP Official to the Chief Proctor approximately five days before the examination. The shipment, as described in the Notice of Shipment (see above) will contain the following:

(1.) Shipment Inventory List
(2.) Proctor's Report of Test Administration Form
(3.) Proctor's Manual
(4.) Student Roster Sheet
(5.) Exams
(6.) IBM Sheets
(7.) Self-Addressed Stamped Return Envelop

This material should be checked immediately for completeness and accuracy.

IT IS ABSOLUTELY NECESSARY TO KEEP THE MATERIALS CONFIDENTIAL AND SECURE AT ALL TIMES.

Within 24 hours of receipt of the shipment, open every carton and check its content. Count the test books and answer sheets, and make sure the number of each agrees with the numbers listed on the Inventory List.

If the quantities of the test books do not agree with the information on the Shipment Inventory List, or if any other item listed is missing, immediately telephone the CMDNJ/SAHP Official collect at (201) 456-4769 charged to account number 139524.

No one is permitted to open or examine any test book except the examinees at the time they are tested. (This regulation does not apply to the chief proctor in instances where examination of a book is necessary, such as to check a reported error or defect. See item F on page 3). Therefore, while test materials are in your possession, the importance of maintaining security cannot be over-emphasized. THE CHIEF PROCTOR IS RESPONSIBLE FOR THE SECURITY OF ALL TEST MATERIAL FROM THE TIME OF RECEIPT TO THE TIME OF RETURN TO THE CMDNJ/SAHP EXAM OFFICE.

After the shipments have been checked and acknowledged, reseal the cartons and store them in a safe, cabinet, or closet to which only the Chief Proctor, or his designate, has access.

D. REGISTRATION OF EXAMINEES

All examinees will be notified by their Program Director to report for registration at 8:30 A.M. on April 28, 1981 at the location specified by the testing institution.

Admit to the examination only those examinees who are listed on the Examinee Identification Form. Use this as a final checklist to ascertain that only those qualified examinees are present in the room before you proceed. All others must leave the room before the examinations begins. If a name was inadvertantly omitted from the form, please satisfy yourself that he/she is duly qualified to take the exam.

Sometimes unavoidable circumstances arise which cause examinees to report late. If the proctor finds the reasons for lateness valid and justifiable, the examinee may be allowed to enter the examination up to 30 minutes after the first session has begun. Write an explanatory note on the Report of Test Administration for any late examinee.

E. DISTRIBUTION OF MATERIALS

(1.) Test Books - Hand each examinee a test book individually. If this is not possible for each row, hand to the examinee nearest the aisle exactly enough books for the number of examinees in that row.

(2.) Answer Sheets - Hand each examinee an answer sheet individually.

As soon as possible after each section of the examination has started, count the unused books and unused answer sheets, and the number of examinees present. These figures added together should equal the total number of books sent you from the CMDNJ/SAHP Official.

(3.) Pencils - Examinees have been instructed to bring with them two ordinary soft lead pencils for use in the examination. It is advisable to have on hand a pencil sharpener, as well as a few #2 ordinary lead pencils for examinees who forget to bring their own.

F. DEFECTIVE TEST MATERIALS

(A) Test Books - If an examinee has a defective test book, take it, replace it with a new one, and direct the examinee to continue work. Both the defective test book and the one used to replace it must also be returned. Report this irregularity in the Proctor's Report Form.

(B) Answer Sheets - If an examinee has a defective answer sheet, take it, replace it with a new answer sheet and direct the examinee to print his/her name and Identification Information and continue to work on the new answer sheet. At the end of the examination, both answer sheets must be collected and clipped together, and returned with a note of explanation written on both. Report this on the Proctor's Report Form.

(C) Test Items - If an examinee thinks a test item is incorrect, assure him you will call it to the attention of the CMDNJ/SAHP Official, then report it on the Report of Test Administration. Please telephone the CMDNJ/SAHP Official to report unusual situations.

G. INTERRUPTION OF THE EXAMINATION

Only one examinee at a time should be allowed to leave the room unescorted. Collect the examinee's test materials before he or she leaves and hold them until the examinee returns. If two or more examinees need to leave the room at the same time, a proctor should accompany them. NEVER LEAVE THE TEST ROOM UNATTENDED.

If an examinee withdraws permanently from an examination prior to completion of all sections, return the examination materials for the completed sections to the CMDNJ/SAHP Official in the usual manner. A note of explanation should be entered on the Proctor's Report, to call attention to the situation.

H. EARLY DISMISSAL

Examinees who finish the test early may be permitted to leave one at a time. Be sure every examinee has signed the answer sheet and has surrendered all examination materials.

I. SUPERVISION DURING EXAMINATION

No one is permitted to use written notes or to make written notes of the contents of a test book. Throughout the examination, the examinee should have nothing on his or her desk but the test book, answer sheet, pencil, and eraser. The use of scratch paper is prohibited. The margins of the test book may be used for any written work preparatory to answering specific questions.

Examinees must not communicate with one another in any way. If you suspect that an examinee is copying the answers of another examinee or is obtaining information from another in any way, carefully observe the examinee throughout the examination to confirm suspicions. Allow the examinee to complete the examination in the new location. The entire situation should be reported in detail, including the following information:

> The identity of all observed examinees by names and social security numbers.

Record this information on the Proctor's Report of Test Administration.

J. COLLECTION OF TEST MATERIALS

When the test is over, collect the test books and answer sheets and be sure you have received one test book and answer sheet from each examinee before you dismiss the examinees.

Protect test materials while the examinees are leaving the room. For example, do not leave test books near exits from the testing room. The proctors should ARRANGE THE USED TEST BOOKS AND ANSWER SHEETS IN SEPARATE ORDER.

NO ONE IS ALLOWED TO INSPECT THE TEST BOOKS OR THE ANSWER SHEETS AFTER THEY HAVE BEEN RETURNED TO A PROCTOR.

K. RETURN OF TEST MATERIALS

At the close of the day, prepare the materials for return to the CMDNJ/SAHP Official in the following way:

(1.) For Immediate Return by First Class Mail, in the envelopes included in the Express Shipment, to:

Hannah D. Zane
Medical Technology Program
School of Allied Health Professions
College of Medicine & Dentistry of NJ
100 Bergen Street
Newark, New Jersey 07103

a. Proctor's Report of Test Administration with appropriate notations, irregularities, etc.
b. Used answer sheets
c. Unused answer sheets
d. Examinee Identification Forms
e. Used test books
f. Unused test books

If questions arise on April 28, 1981, please call CMDNJ/SAHP Official at (201) 456-4769 and charge to account number 139524.

NOTE: IT IS IMPERATIVE THAT THE ABOVE MATERIALS BE BUNDLED AND TAKEN TO AN OUTSIDE MAILBOX OR POST OFFICE ON THE DAY OF THE EXAMINATION SO THAT CMDNJ/SAHP RECEIVES THE TESTS BY FRIDAY MAY 1, 1981. ANY TEST BUNDLES NOT RECEIVED BY THE MORNING MAIL OF MONDAY, MAY 4, 1981, WILL NOT BE SCORED.

III. SPECIFIC INSTRUCTIONS FOR TESTING

(All statements in boxes are to be read aloud)

Before the test begins, refer to the Examination Schedule for proper timing. This schedule MUST be followed.

A. INSTRUCTIONS FOR TESTING

Check to be certain that each of the items on the Check List has been complied with.

After the examinees are seated, say:

> This morning you will take a comprehensive examination in hematology. As a participant in this testing process, you are helping to provide norming data for the entire State of New Jersey for "about-to-graduate" students in the clinical laboratory sciences. The norming data will help to validate the reliability of this examination. The exam is intended to measure the competency level of the graduating student in the clinical laboratory sciences.
>
> It will be used as an equivalency exam that such graduates may take to obtain advanced standing in clinical hematology.
>
> The test has a two-hour time limit.
>
> You should have a #2 soft lead pencil for marking your answer sheet. Ink, ball-point pens, or hard pencils must not be used.
>
> I will now distribute the test booklets and attached answer sheets.

Distribute to each examinee one test booklet. Say:

> Print your full name and your Social Security Number across the top of the front cover of your test booklet. (Pause)

> Turn your answer sheet to print side in a horizontal position in front of you. Print your Social Security Number in the boxes provided under "Student Number" on the left side of the sheet. Ignore the remainder of the boxes requesting name, school, name of test, date of test, and grade. Blacken the corresponding number in each grid below the number in the social security boxes (Pause)
>
> FAILURE TO RECORD THIS INFORMATION CORRECTLY WILL SERIOUSLY DELAY OR EVEN INVALIDATE THE SCORING OF YOUR ANSWER SHEET.
>
> Now inspect your answer sheet. The entire answer sheet contains spaces for answers up to 180 questions even though the actual number of questions in this test will be less than that. All questions on this test will have four choices. The space for the fifth choice is to be ignored. Similarly, numbered answer spaces beyond that for the last question in the test booklet are to be left blank.

After the examinees have recorded their numbers, say:

> You may make any preliminary notes or calculations you wish in the test booklet, but be sure to mark all of your answers on the separate answer sheet as this is essential for valid scoring of your examination. Only those answers properly recorded on the answer will receive credit, and you will not be given extra time to transfer answers after time is called. Your answer marks should be black and heavy enough to completely fill the circles. All marks other than your chosen answers must be erased completely. Multiple marks for a given question will count as a wrong answer; blank answers will also be counted as wrong answers. Do not rest your pencil on the answer sheet when considering an alternative, since this may inadvertently cause marks to interfere with your chosen answer.
>
> When you open your test book to begin, note the total number of questions in the test. This will help you to pace your progress. Are there any questions?

After answering any questions, say:

> BEGIN WORK.

Carefully note the time of beginning, and make a written record of it.

B. 30-MINUTE WARNING

Thirty minutes before the end of the test, say:

> You now have 30 minutes before the end of this test. Examinees who wish to leave may do so one at a time. As you leave, turn in all examination materials to me. (Provide verbal instructions as to where and when the students are to report for their next class or clinical period).

From each examinee who leaves early, collect one test book and one answer sheet. Also check both to make sure the examinee has supplied all the information required including his Name and Social Security number on test booklet, and Social Security number on answer sheet.

C. 10-MINUTE WARNING

Ten minutes before the end of the section, say:

> You now have 10 minutes remaining. Be sure that all of your answers are recorded on the answer sheet. Time will not be extended past the close of this test for transferring your answers.

D. END OF THE TEST

Two hours after the session has begun, say:

> STOP. Close your test book. Check your answer sheet to make sure that your Social Security Number has been properly recorded in the appropriate spaces. Check the cover of your test book to see that you have printed your full name and Social Security Number on it. Answer sheets and test books will be collected in that order. No one may leave the room until all materials have been collected.

From each examinee collect one answer sheet and one test book. After making certain that everything has been collected, say:

> The examination is over. You are dismissed.

E. RECORD OF TIME FOR STUDENTS' COMPLETION OF EXAM.

In order to evaluate the pre-established time allotment for the exam, it is important to know the actual amount of time utilized by students to complete each section of the exam.

Please include in your Report of Test Administration the time spent by students for the test. Please give your impression of the time allotment for the test. With this information, the time table will be modified for future use as necessary.

PROCTOR'S CHECK LIST

Before beginning the examination according to instructions in the Proctor's Manual, be sure that each of the following points have been covered:

______ 1. Are all examinees properly identified and registered?

______ 2. Are examinees seated in alternate seats and where possible, in alternate rows? Are all desks clear?

______ 3. Are Attendance-Score Report Mailing Cards ready for collection from students?

______ 4. Are pencils available for examinees who may need them? They must use standard #2 soft lead pencils with erasers.

______ 5. Are there sufficient test booklets for all examinees? If not, has the CMDNJ-SAHP hotline been called?

NOTE: After all test booklets have been distributed, the number of remaining test booklets should be checked against the number of examinees present and the total number of booklets received. After this check, the unused books should be placed in a secure place.

* * * * * * * * * * *

EXAMINATION TIME SCHEDULE
TUESDAY, APRIL 28, 1981

*8:30 - 8:50 A.M.	Registration
8:50 - 9:00 A.M.	Distribution of materials and instructions
9:00 -11:00 A.M.	Examination

*NOTE: If registration or distribution of materials and instructions require more or less time than allotted, appropriate variation in the above schedule is permitted. However, all examinees at your center must adhere to the same schedule.

E2

Institution: ______________________

Proctor Name: ____________________

PROCTOR'S REPORT OF TEST ADMINISTRATION FORM

1. Average length of time for students to complete exam:

   ______________ minutes

2. Did the students appear to understand the instructions?

   ________ Yes

   ________ No

   Comments:

3. Were the testing facilities adequate?

   ________ Yes

   ________ No

   Comments:

4. Were there any major complaints about the test which the students brought to your attention?

   ________ Yes

   ________ No

   Comments:

General Remarks:

PLEASE RETURN WITH COMPLETED ANSWER SHEETS.

MT/MLT EQUIVALENCY EXAM STUDENT ROSTER SHEET

EXAM CENTER: ______________________ CHEIF PROCTOR: ______________________

STUDENT NAME	SCHOOL	HOME ADDRESS	SOCIAL SECURITY NUMBER
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10. 380			

Program ______________________

Assigned Code No. ______

MLT/MT EQUIVALENCY EXAMINATION

INVENTORY CHECKLIST

______ Proctor's Manual and Attached Checklist

______ Extra Exams

______ Extra IBM Sheets

______ Exams (Rubber-banded together)

______ IBM Sheets

______ Student Roster Sheet

______ Record of Test Administration (Proctor's Report)

______ Self-Addressed Stamped Envelop for Return

Call (201) 456-4769 IMMEDIATELY if the material you have received does not contain the above items.

rev. 1981

MLT Hematology
1981

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MLT EXAM

                    SUMMARY OF TEST STATISTICS

          NUMBER OF ITEMS                      120

          MEAN SCORE                         83.53

          MEDIAN SCORE                       82.58

          STANDARD DEVIATION                 13.55

          RELIABILITY (KR-20)                0.894

          RELIABILITY (KR-21)                0.869

          S.E. OF MEASUREMENT                 4.41

          POSSIBLE LOW SCORE                     0
          POSSIBLE HIGH SCORE                  120

          OBTAINED LOW SCORE                    49
          OBTAINED HIGH SCORE                  110

          NUMBER OF SCORES                      79
               BLANK SCORES                      0
               INVALID SCORES                    0
               VALID SCORES                     79
```

II

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                                        MLT EXAM

                                                       TEST FREQUENCY DISTRIBUTION

 RAW    STANDARD    PER                          CUM
SCORE    SCORE    CENTILE   PERCENT    FREQ    FREQ
                                                              EACH * REPRESENTS  1 PERSON(S)
  110     695        99        2.5       2      79            **
  109     688        97        0.0       0      77
  108     681        97        0.0       0      77
  107     673        97        1.3       1      77            *
  106     666        95        2.5       2      76            **
  105     658        94        0.0       0      74
  104     651        93        1.3       1      74            *
  103     644        91        2.5       2      73            **
  102     636        89        1.3       1      71            *
  101     629        85        6.3       5      70            *****
  100     622        82        0.0       0      65
   99     614        82        0.0       0      65
   98     607        82        1.3       1      65            *
   97     599        80        1.3       1      64            *
   96     592        79        1.3       1      63            *
   95     585        78        1.3       1      62            *
   94     577        77        1.3       1      61            *
   93     570        75        1.3       1      60            *
   92     563        73        3.8       3      59            ***
   91     555        69        3.8       3      56            ***
   90     548        66        1.3       1      53            *
   89     540        66        0.0       0      52
   88     533        65        1.3       1      52            *
   87     526        63        2.5       2      51            **
   86     518        61        1.3       1      49            *
   85     511        60        1.3       1      48            *
   84     503        58        2.5       2      47            **
   83     496        53        7.6       6      45            ******
   82     489        48        2.5       2      39            **
   81     481        46        1.3       1      37            *
   80     474        43        5.1       4      36            ****
   79     467        38        5.1       4      32            ****
   78     459        35        0.0       0      28
   77     452        34        3.8       3      28            ***
   76     444        30        2.5       2      25            **
   75     437        28        2.5       2      23            **
   74     430        25        3.8       3      21            ***
   73     422        22        2.5       2      18            **
   72     415        19        3.8       3      16            ***
   71     408        15        3.8       3      13            ***
   70     400        12        1.3       1      10            *
   69     393        10        2.5       2       9            **
   68     385         8        1.3       1       7            *
   67     378         8        0.0       0       6
   66     371         8        0.0       0       6
```

380

380

FORM 411-3

PRINTED IN U.S.A.

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      65        363         8        0.0        0       6
      64        356         7        1.3        1       6           *
      63        348         6        0.0        0       5
      62        341         6        0.0        0       5
      61        334         5        2.5        2       5           **
      60        326         4        0.0        0       3
      59        319         4        0.0        0       3
      58        312         4        0.0        0       3
      57        304         4        0.0        0       3
      56        297         4        0.0        0       3
      55        289         3        2.5        2       3           **
      54        282         1        0.0        0       1
      53        275         1        0.0        0       1
      52        267         1        0.0        0       1
      51        260         1        0.0        0       1
      50        253         1        0.0        0       1
      49        245         1        1.3        1       1           *
```

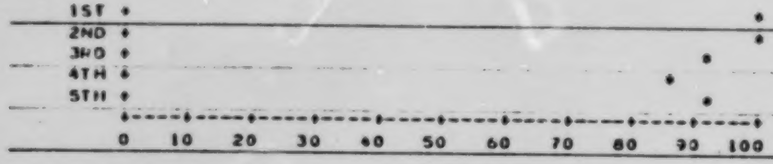
FORM 1411-3

PRINTED IN U.S.A.

THE QUINTILE GRAPH AND MATRIX OF RESPONSES
APPEARING WITH EACH ITEM ARE BASED ON THE
STATISTICS INDICATED IN THE TABLE BELOW :

QUINTILE	SAMPLE SIZE	PROPORTION	SCORE RANGE
1ST	16	0.20	97 - 110
2ND	16	0.20	85 - 96
3RD	15	0.19	80 - 8[illegible]
4TH	16	0.20	73 - 79
5TH	16	0.20	49 - 72

ITEM 1 PERCENT OF CORRECT RESPONSE BY FIFTHS

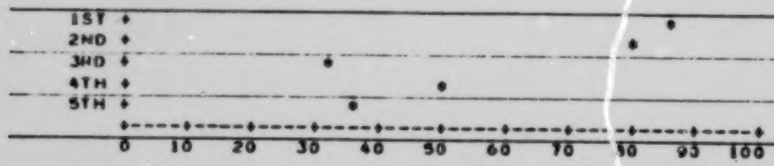


```
MATRIX OF RESPONSES BY FIFTHS                    B IS CORRECT RESPONSE

          A    (B)    C     D     E     F     G     H     I     J  OMIT
 1ST      0    16     0     0     0     0     0     0     0     0     0
 2ND      0    16     0     0     0     0     0     0     0     0     0
 3RD      1    14     0     0     0     0     0     0     0     0     0
 4TH      2    14     0     0     0     0     0     0     0     0     0
 5TH      3    15     0     1     0     0     0     0     0     0     0

PROP   0.04 (0.95) 0.00  0.01  0.00  0.00  0.00  0.00  0.00  0.00  0.00
RPBI  -0.08 (0.21) 0.00 -0.29  0.00  0.00  0.00  0.00  0.00  0.00  0.00
```

ITEM 2 PERCENT OF CORRECT RESPONSE BY FIFTHS

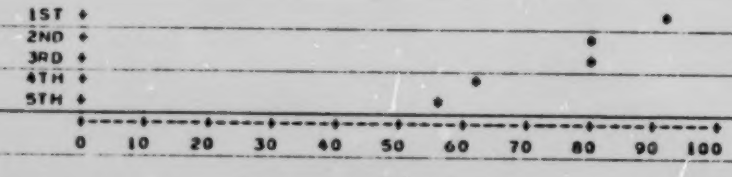


```
MATRIX OF RESPONSES BY FIFTHS                    B IS CORRECT RESPONSE

          A    (B)    C     D     E     F     G     H     I     J  OMIT
 1ST      0    14     1     1     0     0     0     0     0     0     0
 2ND      1    13     1     1     0     0     0     0     0     0     0
 3RD      6     5     2     2     0     0     0     0     0     0     0
 4TH      5     8     1     2     0     0     0     0     0     0     0
 5TH      6     6     2     2     0     0     0     0     0     0     0

PROP   0.23 (0.58) 0.09  0.10  0.00  0.00  0.00  0.00  0.00  0.00  0.00
RPBI  -0.24 (0.37)-0.13 -0.14  0.00  0.00  0.00  0.00  0.00  0.00  0.00
```

ITEM 3 PERCENT OF CORRECT RESPONSE BY FIFTHS

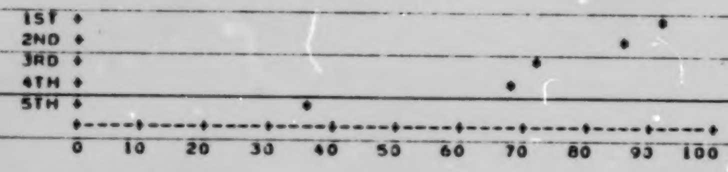


```
MATRIX OF RESPONSES BY FIFTHS                    C IS CORRECT RESPONSE

          A     B    (C)    D     E     F     G     H     I     J  OMIT
 1ST      1     0    15     0     0     0     0     0     0     0     0
 2ND      2     0    13     1     0     0     0     0     0     0     0
 3RD      3     0    12     0     0     0     0     0     0     0     0
 4TH      4     0    10     2     0     0     0     0     0     0     0
 5TH      3     1     9     3     0     0     0     0     0     0     0

PROP   0.16  0.01 (0.75) 0.08  0.00  0.00  0.00  0.00  0.00  0.00  0.00
RPBI  -0.21 -0.24 (0.39)-0.24  0.00  0.00  0.00  0.00  0.00  0.00  0.00
```

ITEM 4 PERCENT OF CORRECT RESPONSE BY FIFTHS

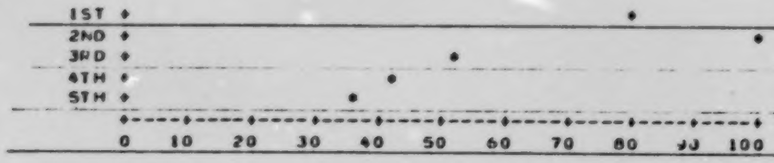


```
MATRIX OF RESPONSES BY FIFTHS                    B IS CORRECT RESPONSE

          A    (B)    C     D     E     F     G     H     I     J  OMIT
 1ST      0    15     0     1     0     0     0     0     0     0     0
 2ND      1    14     0     1     0     0     0     0     0     0     0
 3RD      2    11     0     2     0     0     0     0     0     0     0
 4TH      4    11     0     1     0     0     0     0     0     0     0
 5TH      3     6     3     4     0     0     0     0     0     0     0

PROP   0.13 (0.72) 0.04  0.11  0.00  0.00  0.00  0.00  0.00  0.00  0.00
RPBI  -0.28 (0.47)-0.31 -0.19  0.00  0.00  0.00  0.00  0.00  0.00  0.00
```

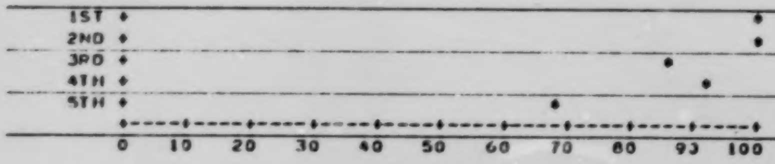
ITEM 5 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS B IS CORRECT RESPONSE

	A	(B)	C	D	E	F	G	H	I	J	OMIT
1ST	1	13	2	0	0	0	0	0	0	0	0
2ND	0	16	0	0	0	0	0	0	0	0	0
3RD	0	8	6	1	0	0	0	0	0	0	0
4TH	2	7	6	1	0	0	0	0	0	0	0
5TH	3	6	5	2	0	0	0	0	0	0	0
PROP	0.08	(0.63)	0.24	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.23	(0.43)	-0.21	-0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00

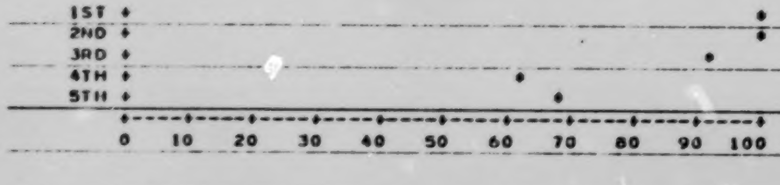
ITEM 6 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS B IS CORRECT RESPONSE

	A	(B)	C	D	E	F	G	H	I	J	OMIT
1ST	0	16	0	0	0	0	0	0	0	0	0
2ND	0	16	0	0	0	0	0	0	0	0	0
3RD	1	13	1	0	0	0	0	0	0	0	0
4TH	0	15	1	0	0	0	0	0	0	0	0
5TH	4	11	1	0	0	0	0	0	0	0	0
PROP	0.06	(0.90)	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.31	(0.31)	-0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

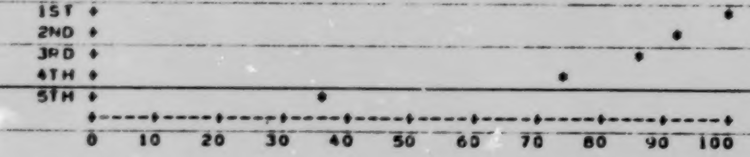
ITEM 7 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS A IS CORRECT RESPONSE

	(A)	B	C	D	E	F	G	H	I	J	OMIT
1ST	16	0	0	0	0	0	0	0	0	0	0
2ND	16	0	0	0	0	0	0	0	0	0	0
3RD	14	0	1	0	0	0	0	0	0	0	0
4TH	10	2	4	0	0	0	0	0	0	0	0
5TH	11	5	0	0	0	0	0	0	0	0	0
PROP	(0.85)	0.09	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	(0.43)	-0.43	-0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ITEM 8 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS D IS CORRECT RESPONSE

	A	B	C	(D)	E	F	G	H	I	J	OMIT
1ST	0	0	0	16	0	0	0	0	0	0	0
2ND	0	1	0	15	0	0	0	0	0	0	0
3RD	0	0	2	13	0	0	0	0	0	0	0
4TH	0	1	3	12	0	0	0	0	0	0	0
5TH	2	2	5	6	0	0	0	0	0	0	1
PROP	0.03	0.05	0.13	(0.78)	0.00	0.00	0.00	0.00	0.00	0.00	0.01
RPBI	-0.18	-0.21	-0.28	(0.44)	0.00	0.00	0.00	0.00	0.00	0.00	-0.10

```
ITEM   9      PERCENT OF CORRECT RESPONSE BY FIFTHS             MATRIX OF RESPONSES BY FIFTHS                         D IS CORRECT RESPONSE

                                                                          A      B      C    (D)      E      F      G      H      I      J   OMIT
      1ST +                                                 *   1ST       0      0      0     16      0      0      0      0      0      0      0
      2ND +                                                 *   2ND       0      0      0     16      0      0      0      0      0      0      0
      3RD +                                                 *   3RD       0      0      0     15      0      0      0      0      0      0      0
      4TH +                                                 *   4TH       0      0      0     16      0      0      0      0      0      0      0
      5TH +                                 *                   5TH       0      1      4     11      0      0      0      0      0      0      0
          +----+----+----+----+----+----+----+----+----+----+
          0    10   20   30   40   50   60   70   80   90  100  PROP   0.00   0.01   0.05 (0.94)   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                                RPBI   0.00  -0.19  -0.26 (0.32)   0.00   0.00   0.00   0.00   0.00   0.00   0.00

ITEM  10      PERCENT OF CORRECT RESPONSE BY FIFTHS             MATRIX OF RESPONSES BY FIFTHS                         A IS CORRECT RESPONSE

                                                                        (A)      B      C      D      E      F      G      H      I      J   OMIT
      1ST +                                                 *   1ST      16      0      0      0      0      0      0      0      0      0      0
      2ND +                                                 *   2ND      16      0      0      0      0      0      0      0      0      0      0
      3RD +                                                 *   3RD      15      0      0      0      0      0      0      0      0      0      0
      4TH +                                             *       4TH      15      0      1      0      0      0      0      0      0      0      0
      5TH +                                             *       5TH      15      0      1      0      0      0      0      0      0      0      0
          +----+----+----+----+----+----+----+----+----+----+
          0    10   20   30   40   50   60   70   80   90  100  PROP (0.97)   0.00   0.03   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                                RPBI (0.13)   0.00  -0.13   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00

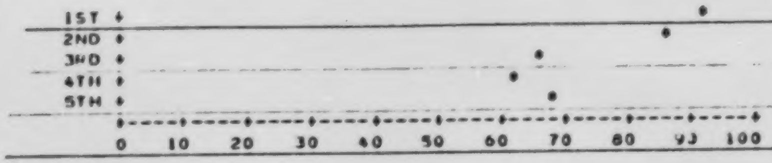
ITEM  11      PERCENT OF CORRECT RESPONSE BY FIFTHS             MATRIX OF RESPONSES BY FIFTHS                         B IS CORRECT RESPONSE

                                                                          A    (B)      C      D      E      F      G      H      I      J   OMIT
      1ST +                                                 *   1ST       0     16      0      0      0      0      0      0      0      0      0
      2ND +                                          *          2ND       0     14      1      1      0      0      0      0      0      0      0
      3RD +                                                 *   3RD       0     15      0      0      0      0      0      0      0      0      0
      4TH +                                             *       4TH       0     15      1      0      0      0      0      0      0      0      0
      5TH +                                    *                5TH       1     12      1      2      0      0      0      0      0      0      0
          +----+----+----+----+----+----+----+----+----+----+
          0    10   20   30   40   50   60   70   80   90  100  PROP   0.01 (0.91)   0.04   0.04   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                                RPBI  -0.24 (0.35)-0.13  -0.26   0.00   0.00   0.00   0.00   0.00   0.00   0.00

ITEM  12      PERCENT OF CORRECT RESPONSE BY FIFTHS             MATRIX OF RESPONSES BY FIFTHS                         A IS CORRECT RESPONSE

                                                                        (A)      B      C      D      E      F      G      H      I      J   OMIT
      1ST +                                                 *   1ST      16      0      0      0      0      0      0      0      0      0      0
      2ND +                                                 *   2ND      16      0      0      0      0      0      0      0      0      0      0
      3RD +                                                 *   3RD      15      0      0      0      0      0      0      0      0      0      0
      4TH +                                                 *   4TH      16      0      0      0      0      0      0      0      0      0      0
      5TH +                                          *          5TH      14      0      1      1      0      0      0      0      0      0      0
          +----+----+----+----+----+----+----+----+----+----+
          0    10   20   30   40   50   60   70   80   90  100  PROP (0.97)   0.00   0.01   0.01   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                                RPBI (0.34)   0.00  -0.29  -0.19   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

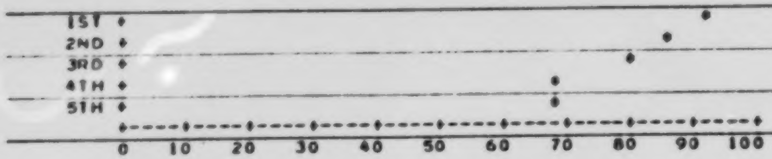
ITEM 13 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS D IS CORRECT RESPONSE

	A	B	C	(D)	E	F	G	H	I	J	OMIT
1ST	1	0	0	15	0	0	0	0	0	0	0
2ND	2	0	0	14	0	0	0	0	0	0	0
3RD	3	1	1	10	0	0	0	0	0	0	0
4TH	4	0	2	10	0	0	0	0	0	0	0
5TH	3	2	0	11	0	0	0	0	0	0	0
PROP	0.16	0.04	0.04	(0.76)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.12	-0.15	-0.04	(0.20)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

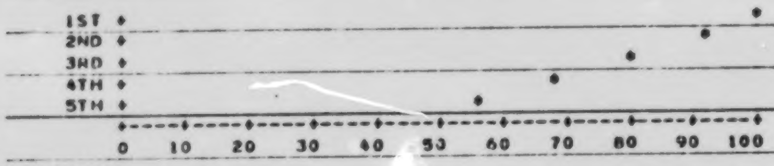
ITEM 14 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS B IS CORRECT RESPONSE

	A	(B)	C	D	E	F	G	H	I	J	OMIT
1ST	1	15	0	0	0	0	0	0	0	0	0
2ND	1	14	1	0	0	0	0	0	0	0	0
3RD	3	12	0	0	0	0	0	0	0	0	0
4TH	5	11	0	0	0	0	0	0	0	0	0
5TH	3	11	0	2	0	0	0	0	0	0	0
PROP	0.16	(0.80)	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.20	(0.28)	0.01	-0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00

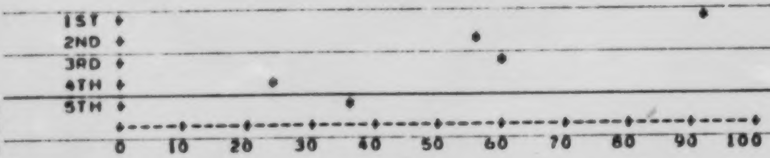
ITEM 15 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS B IS CORRECT RESPONSE

	A	(B)	C	D	E	F	G	H	I	J	OMIT
1ST	0	16	0	0	0	0	0	0	0	0	0
2ND	0	15	0	1	0	0	0	0	0	0	0
3RD	1	12	2	0	0	0	0	0	0	0	0
4TH	0	11	2	3	0	0	0	0	0	0	0
5TH	0	9	4	3	0	0	0	0	0	0	0
PROP	0.01	(0.80)	0.10	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	0.00	(0.41)	-0.25	-0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00

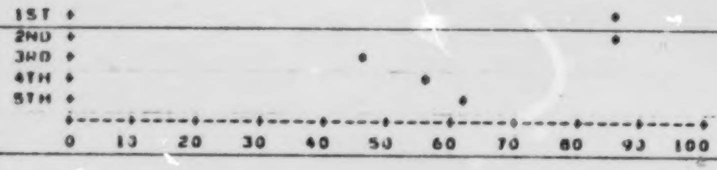
ITEM 16 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS D IS CORRECT RESPONSE

	A	B	C	(D)	E	F	G	H	I	J	OMIT
1ST	0	0	1	15	0	0	0	0	0	0	0
2ND	0	2	5	9	0	0	0	0	0	0	0
3RD	1	4	1	9	0	0	0	0	0	0	0
4TH	1	7	4	4	0	0	0	0	0	0	0
5TH	2	7	1	6	0	0	0	0	0	0	0
PROP	0.05	0.25	0.15	(0.54)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.15	-0.35	-0.05	(0.41)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

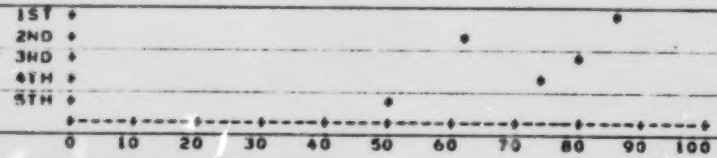
ITEM 17 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS A IS CORRECT RESPONSE

	(A)	B	C	D	E	F	G	H	I	J	OMIT
1ST	14	0	2	0	0	0	0	0	0	0	0
2ND	14	0	1	1	0	0	0	0	0	0	0
3RD	7	0	5	3	0	0	0	0	0	0	0
4TH	9	1	1	5	0	0	0	0	0	0	0
5TH	10	0	2	4	0	0	0	0	0	0	0
PROP	(0.68)	0.01	0.14	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	(0.21)	-0.04	0.00	-0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00

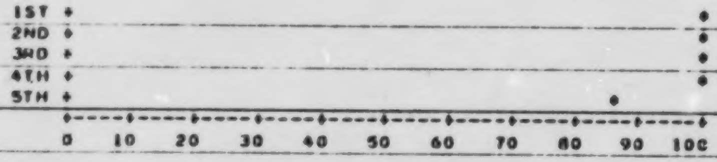
ITEM 18 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS C IS CORRECT RESPONSE

	A	B	(C)	D	E	F	G	H	I	J	OMIT
1ST	0	2	14	0	0	0	0	0	0	0	0
2ND	2	4	10	0	0	0	0	0	0	0	0
3RD	1	1	12	1	0	0	0	0	0	0	0
4TH	2	2	12	0	0	0	0	0	0	0	0
5TH	5	3	8	0	0	0	0	0	0	0	0
PROP	0.13	0.15	(0.71)	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.29	-0.04	(0.24)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

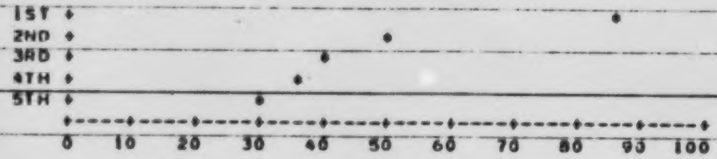
ITEM 19 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS D IS CORRECT RESPONSE

	A	B	C	(D)	E	F	G	H	I	J	OMIT
1ST	0	0	0	16	0	0	0	0	0	0	0
2ND	0	0	0	16	0	0	0	0	0	0	0
3RD	0	0	0	15	0	0	0	0	0	0	0
4TH	0	0	0	16	0	0	0	0	0	0	0
5TH	0	1	1	14	0	0	0	0	0	0	0
PROP	0.00	0.01	0.01	(0.97)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	0.00	-0.19	-0.24	(0.30)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ITEM 20 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS C IS CORRECT RESPONSE

	A	B	(C)	D	E	F	G	H	I	J	OMIT
1ST	0	0	14	2	0	0	0	0	0	0	0
2ND	1	1	8	6	0	0	0	0	0	0	0
3RD	6	0	6	3	0	0	0	0	0	0	0
4TH	2	1	6	7	0	0	0	0	0	0	0
5TH	2	3	5	6	0	0	0	0	0	0	0
PROP	0.14	0.06	(0.49)	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.15	-0.21	(0.39)	-0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00

```
ITEM  21      PERCENT OF CORRECT RESPONSE BY FIFTHS

      1ST +                                                      *
      2ND +                                                   *
      3RD +                                                   *
      4TH +                                                      *
      5TH +                                               *
          +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
          0    10    20    30    40    50    60    70    80    90   100

MATRIX OF RESPONSES BY FIFTHS                      B IS CORRECT RESPONSE

            A    (B)      C      D      E      F      G      H      I      J   OMIT
  1ST       1     15      0      0      0      0      0      0      0      0      0
  2ND       0     14      1      1      0      0      0      0      0      0      0
  3RD       1     13      0      1      0      0      0      0      0      0      0
  4TH       0     15      0      1      0      0      0      0      0      0      0
  5TH       0     13      2      1      0      0      0      0      0      0      0

 PROP    0.03 (0.89) 0.04   0.05   0.00   0.00   0.00   0.00   0.00   0.00   0.00
 RPBI    0.06 (0.20)-0.27  -0.10   0.00   0.00   0.00   0.00   0.00   0.00   0.00


ITEM  22      PERCENT OF CORRECT RESPONSE BY FIFTHS

      1ST +                                                  *
      2ND +                                                  *
      3RD +                              *
      4TH +                             *
      5TH +                                        *
          +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
          0    10    20    30    40    50    60    70    80    90   100

MATRIX OF RESPONSES BY FIFTHS                      C IS CORRECT RESPONSE

            A      B    (C)      D      E      F      G      H      I      J   OMIT
  1ST       0      2     14      0      0      0      0      0      0      0      0
  2ND       1      1     14      0      0      0      0      0      0      0      0
  3RD       1      5      8      1      0      0      0      0      0      0      0
  4TH       4      1      8      3      0      0      0      0      0      0      0
  5TH       3      2     11      0      0      0      0      0      0      0      0

 PROP    0.11   0.14 (0.70) 0.05   0.00   0.00   0.00   0.00   0.00   0.00   0.00
 RPBI   -0.29   0.02 (0.23)-0.10   0.00   0.00   0.00   0.00   0.00   0.00   0.00


ITEM  23      PERCENT OF CORRECT RESPONSE BY FIFTHS

      1ST +                                                          *
      2ND +                             *
      3RD +                                                  *
      4TH +                                           *
      5TH +                                              *
          +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
          0    10    20    30    40    50    60    70    80    90   100

MATRIX OF RESPONSES BY FIFTHS                      A IS CORRECT RESPONSE

          (A)      B      C      D      E      F      G      H      I      J   OMIT
  1ST      15      0      0      0      0      0      0      0      0      0      0
  2ND       8      7      0      1      0      0      0      0      0      0      0
  3RD      13      0      0      2      0      0      0      0      0      0      0
  4TH      12      1      2      1      0      0      0      0      0      0      0
  5TH      13      3      0      0      0      0      0      0      0      0      0

 PROP  (0.78)  0.14   0.03   0.05   0.00   0.00   0.00   0.00   0.00   0.00   0.00
 RPBI  (0.03)  0.01  -0.07  -0.02   0.00   0.00   0.00   0.00   0.00   0.00   0.00


ITEM  24      PERCENT OF CORRECT RESPONSE BY FIFTHS

      1ST +                                                      *
      2ND +                                                      *
      3RD +                                                      *
      4TH +                                                           *
      5TH +                                               *
          +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
          0    10    20    30    40    50    60    70    80    90   100

MATRIX OF RESPONSES BY FIFTHS                      C IS CORRECT RESPONSE

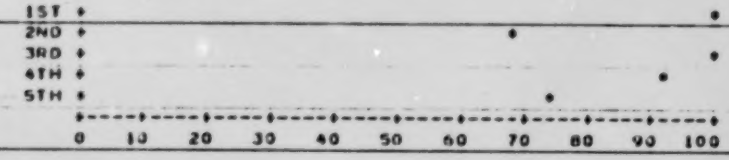
            A      B    (C)      D      E      F      G      H      I      J   OMIT
  1ST       0      1     15      0      0      0      0      0      0      0      0
  2ND       0      1     15      0      0      0      0      0      0      0      0
  3RD       0      1     14      0      0      0      0      0      0      0      0
  4TH       0      0     16      0      0      0      0      0      0      0      0
  5TH       0      0     13      3      0      0      0      0      0      0      0

 PROP    0.00   0.04 (0.92) 0.04   0.00   0.00   0.00   0.00   0.00   0.00   0.00
 RPBI    0.00   0.10 (0.19)-0.37   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

400

401

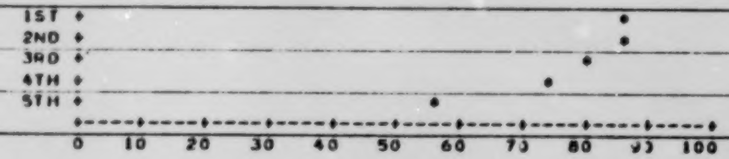
ITEM 25 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS D IS CORRECT RESPONSE

	A	B	C	(D)	E	F	G	H	I	J	OMIT
1ST	0	0	0	16	0	0	0	0	0	0	0
2ND	5	0	0	11	0	0	0	0	0	0	0
3RD	0	0	0	15	0	0	0	0	0	0	0
4TH	1	0	0	15	0	0	0	0	0	0	0
5TH	4	0	0	12	0	0	0	0	0	0	0
PROP	0.13	0.00	0.00	(0.87)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.24	0.00	0.00	(0.24)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

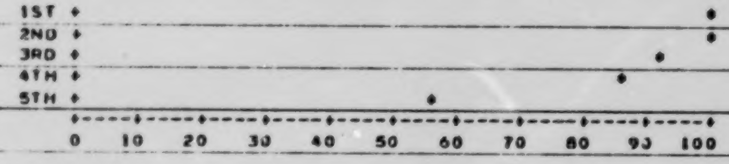
ITEM 26 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS C IS CORRECT RESPONSE

	A	B	(C)	D	E	F	G	H	I	J	OMIT
1ST	0	1	14	1	0	0	0	0	0	0	0
2ND	0	0	14	2	0	0	0	0	0	0	0
3RD	1	0	12	2	0	0	0	0	0	0	0
4TH	0	2	12	2	0	0	0	0	0	0	0
5TH	0	2	9	5	0	0	0	0	0	0	0
PROP	0.01	0.06	(0.77)	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.00	-0.17	(0.30)	-0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00

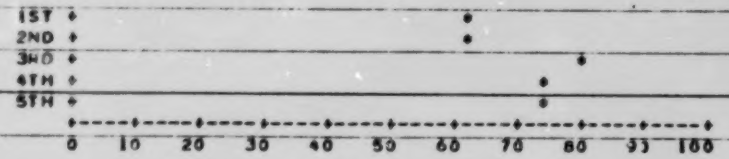
ITEM 27 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS B IS CORRECT RESPONSE

	A	(B)	C	D	E	F	G	H	I	J	OMIT
1ST	0	16	0	0	0	0	0	0	0	0	0
2ND	0	16	0	0	0	0	0	0	0	0	0
3RD	0	14	0	1	0	0	0	0	0	0	0
4TH	0	14	1	1	0	0	0	0	0	0	0
5TH	1	9	2	4	0	0	0	0	0	0	0
PROP	0.01	(0.87)	0.04	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.12	(0.41)	-0.24	-0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ITEM 28 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS C IS CORRECT RESPONSE

	A	B	(C)	D	E	F	G	H	I	J	OMIT
1ST	1	5	10	0	0	0	0	0	0	0	0
2ND	1	5	10	0	0	0	0	0	0	0	0
3RD	0	3	12	0	0	0	0	0	0	0	0
4TH	2	1	12	1	0	0	0	0	0	0	0
5TH	0	4	12	0	0	0	0	0	0	0	0
PROP	0.05	0.23	(0.71)	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	0.03	0.06	(0.05)	-0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00

```
ITEM  29     PERCENT OF CORRECT RESPONSE BY FIFTHS            MATRIX OF RESPONSES BY FIFTHS              A IS CORRECT RESPONSE

                                                                       (A)     B     C     D     E     F     G     H     I     J  OMIT
  1ST +                                       *                 1ST     13     1     0     2     0     0     0     0     0     0     0
  2ND +                                          *              2ND     14     0     1     1     0     0     0     0     0     0     0
  3RD +                                   *                     3RD     11     0     1     3     0     0     0     0     0     0     0
  4TH +                           *                             4TH      9     3     1     3     0     0     0     0     0     0     0
  5TH +           *                                             5TH      4     2     4     5     0     0     0     0     0     0     1
      +----+----+----+----+----+----+----+----+----+----+
      0   10   20   30   40   50   60   70   80   90  100       PROP  (0.65)  0.08  0.09  0.18  0.00  0.00  0.00  0.00  0.00  0.00  0.01
                                                                RPBI  (0.44)-0.14 -0.23 -0.22  0.00  0.00  0.00  0.00  0.00  0.00 -0.24

ITEM  30     PERCENT OF CORRECT RESPONSE BY FIFTHS            MATRIX OF RESPONSES BY FIFTHS              A IS CORRECT RESPONSE

                                                                       (A)     B     C     D     E     F     G     H     I     J  OMIT
  1ST +  *                                                      1ST      1    11     1     3     0     0     0     0     0     0     0
  2ND +        *                                                2ND      3    10     0     3     0     0     0     0     0     0     0
  3RD +     *                                                   3RD      2    12     0     1     0     0     0     0     0     0     0
  4TH +     *                                                   4TH      2     8     0     6     0     0     0     0     0     0     0
  5TH +           *                                             5TH      4     8     1     3     0     0     0     0     0     0     0
      +----+----+----+----+----+----+----+----+----+----+
      0   10   20   30   40   50   60   70   80   90  100       PROP  (0.15)  0.62  0.03  0.20  0.00  0.00  0.00  0.00  0.00  0.00  0.00
                                                                RPBI  (0.16)  0.22 -0.03 -0.11  0.00  0.00  0.00  0.00  0.00  0.00  0.00

ITEM  31     PERCENT OF CORRECT RESPONSE BY FIFTHS            MATRIX OF RESPONSES BY FIFTHS              B IS CORRECT RESPONSE

                                                                         A   (B)     C     D     E     F     G     H     I     J  OMIT
  1ST +                                       *                 1ST      2    13     1     0     0     0     0     0     0     0     0
  2ND +                                 *                       2ND      3    11     1     0     0     0     0     0     0     0     1
  3RD +                      *                                  3RD      4     7     4     0     0     0     0     0     0     0     0
  4TH +                        *                                4TH      4     8     4     0     0     0     0     0     0     0     0
  5TH +                           *                             5TH      4     9     3     0     0     0     0     0     0     0     0
      +----+----+----+----+----+----+----+----+----+----+
      0   10   20   30   40   50   60   70   80   90  100       PROP    0.22 (0.61) 0.16  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.01
                                                                RPBI   -0.09 (0.19)-0.18  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.10

ITEM  32     PERCENT OF CORRECT RESPONSE BY FIFTHS            MATRIX OF RESPONSES BY FIFTHS              B IS CORRECT RESPONSE

                                                                         A   (B)     C     D     E     F     G     H     I     J  OMIT
  1ST +                                                 *       1ST      0    16     0     0     0     0     0     0     0     0     0
  2ND +                                 *                       2ND      1    11     0     4     0     0     0     0     0     0     0
  3RD +                                             *           3RD      0    14     1     0     0     0     0     0     0     0     0
  4TH +                                             *           4TH      1    15     0     0     0     0     0     0     0     0     0
  5TH +                                       *                 5TH      0    13     0     3     0     0     0     0     0     0     0
      +----+----+----+----+----+----+----+----+----+----+
      0   10   20   30   40   50   60   70   80   90  100       PROP    0.03 (0.87) 0.01  0.09  0.00  0.00  0.00  0.00  0.00  0.00  0.00
                                                                RPBI    0.02 (0.10) 0.00 -0.13  0.00  0.00  0.00  0.00  0.00  0.00  0.00
```

404

405
1

```
ITEM  33      PERCENT OF CORRECT RESPONSE BY FIFTHS          MATRIX OF RESPONSES BY FIFTHS                C IS CORRECT RESPONSE

                                                                      A      B     (C)     D      E      F      G      H      I      J   OMIT
  1ST +                                             *         1ST     0      1     15      0      0      0      0      0      0      0      0
  2ND +                              *                        2ND     0      3     10      3      0      0      0      0      0      0      0
  3RD +                         *                             3RD     3      3      8      1      0      0      0      0      0      0      0
  4TH +                    *                                  4TH     2      5      7      2      0      0      0      0      0      0      0
  5TH +                 *                                     5TH     2      4      6      4      0      0      0      0      0      0      0
      +----+----+----+----+----+----+----+----+----+----+
      0    10   20   30   40   50   60   70   80   90   100     PROP   0.09   0.20 (0.58) 0.13   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                               RPBI  -0.16  -0.15 (0.40)-0.27   0.00   0.00   0.00   0.00   0.00   0.00   0.00


ITEM  34      PERCENT OF CORRECT RESPONSE BY FIFTHS          MATRIX OF RESPONSES BY FIFTHS                C IS CORRECT RESPONSE

                                                                      A      B     (C)     D      E      F      G      H      I      J   OMIT
  1ST +                                                 *     1ST     0      0     16      0      0      0      0      0      0      0      0
  2ND +                                          *            2ND     0      1     14      1      0      0      0      0      0      0      0
  3RD +                             *                         3RD     2      4      9      0      0      0      0      0      0      0      0
  4TH +                                    *                  4TH     0      3     12      1      0      0      0      0      0      0      0
  5TH +                                 *                     5TH     1      3     11      1      0      0      0      0      0      0      0
      +----+----+----+----+----+----+----+----+----+----+
      0    10   20   30   40   50   60   70   80   90   100     PROP   0.04   0.14 (0.78) 0.04   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                               RPBI  -0.18  -0.20 (0.33)-0.15   0.00   0.00   0.00   0.00   0.00   0.00   0.00


ITEM  35      PERCENT OF CORRECT RESPONSE BY FIFTHS          MATRIX OF RESPONSES BY FIFTHS                D IS CORRECT RESPONSE

                                                                      A      B      C     (D)     E      F      G      H      I      J   OMIT
  1ST +                                                 *     1ST     0      0      0     16      0      0      0      0      0      0      0
  2ND +                                          *            2ND     0      1      0     14      1      0      0      0      0      0      0
  3RD +                                          *            3RD     0      2      0     13      0      0      0      0      0      0      0
  4TH +                                       *               4TH     1      1      1     13      0      0      0      0      0      0      0
  5TH +                                 *                     5TH     1      1      3     11      0      0      0      0      0      0      0
      +----+----+----+----+----+----+----+----+----+----+
      0    10   20   30   40   50   60   70   80   90   100     PROP   0.03   0.06   0.05 (0.85) 0.01   0.00   0.00   0.00   0.00   0.00   0.00
                                                               RPBI  -0.17  -0.06  -0.27 (0.25) 0.10   0.00   0.00   0.00   0.00   0.00   0.00


ITEM  36      PERCENT OF CORRECT RESPONSE BY FIFTHS          MATRIX OF RESPONSES BY FIFTHS                A IS CORRECT RESPONSE

                                                                     (A)     B      C      D      E      F      G      H      I      J   OMIT
  1ST +                                             *         1ST    15      1      0      0      0      0      0      0      0      0      0
  2ND +                                                 *     2ND    16      0      0      0      0      0      0      0      0      0      0
  3RD +                                             *         3RD    14      1      0      0      0      0      0      0      0      0      0
  4TH +                                       *               4TH    13      3      0      0      0      0      0      0      0      0      0
  5TH +                              *                        5TH    10      4      1      1      0      0      0      0      0      0      0
      +----+----+----+----+----+----+----+----+----+----+
      0    10   20   30   40   50   60   70   80   90   100     PROP  (0.86) 0.11   0.01   0.01   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                               RPBI  (0.39)-0.26  -0.16  -0.29   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

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ITEM  37      PERCENT OF CORRECT RESPONSE BY FIFTHS           MATRIX OF RESPONSES BY FIFTHS            B IS CORRECT RESPONSE

                                                                          A    (B)      C      D      E      F      G      H      I      J   OMIT
    1ST +                                                 *   1ST       0     16      0      0      0      0      0      0      0      0      0
    2ND +                                    *                2ND       0     12      1      3      0      0      0      0      0      0      0
    3RD +                         *                           3RD       1      8      2      4      0      0      0      0      0      0      0
    4TH +                                 *                   4TH       1     11      0      4      0      0      0      0      0      0      0
    5TH +                    *                                5TH       3      7      3      3      0      0      0      0      0      0      0
        +----+----+----+----+----+----+----+----+----+----+
        0   10   20   30   40   50   60   70   80   90  100   PROP   0.06 (0.68)   0.08   0.18   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                              RPBI  -0.25 (0.40)  -0.24  -0.16   0.00   0.00   0.00   0.00   0.00   0.00   0.00

ITEM  38      PERCENT OF CORRECT RESPONSE BY FIFTHS           MATRIX OF RESPONSES BY FIFTHS            C IS CORRECT RESPONSE

                                                                          A      B    (C)      D      E      F      G      H      I      J   OMIT
    1ST +                                                 *   1ST       0      0     16      0      0      0      0      0      0      0      0
    2ND +                                    *                2ND       1      1     12      2      0      0      0      0      0      0      0
    3RD +                   *                                 3RD       4      4      6      1      0      0      0      0      0      0      0
    4TH +                 *                                   4TH       5      3      6      2      0      0      0      0      0      0      0
    5TH +        *                                            5TH       4      6      3      3      0      0      0      0      0      0      0
        +----+----+----+----+----+----+----+----+----+----+
        0   10   20   30   40   50   60   70   80   90  100   PROP   0.18   0.18 (0.54)   0.10   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                              RPBI  -0.27  -0.33 (0.55)  -0.14   0.00   0.00   0.00   0.00   0.00   0.00   0.00

ITEM  39      PERCENT OF CORRECT RESPONSE BY FIFTHS           MATRIX OF RESPONSES BY FIFTHS            A IS CORRECT RESPONSE

                                                                        (A)      B      C      D      E      F      G      H      I      J   OMIT
    1ST +                                                 *   1ST      16      0      0      0      0      0      0      0      0      0      0
    2ND +                                       *             2ND      13      2      0      1      0      0      0      0      0      0      0
    3RD +                                   *                 3RD      11      3      1      0      0      0      0      0      0      0      0
    4TH +                              *                      4TH      10      5      0      1      0      0      0      0      0      0      0
    5TH +                 *                                   5TH       6      6      0      4      0      0      0      0      0      0      0
        +----+----+----+----+----+----+----+----+----+----+
        0   10   20   30   40   50   60   70   80   90  100   PROP (0.71)   0.20   0.01   0.08   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                              RPBI (0.44)  -0.31  -0.00  -0.29   0.00   0.00   0.00   0.00   0.00   0.00   0.00

ITEM  40      PERCENT OF CORRECT RESPONSE BY FIFTHS           MATRIX OF RESPONSES BY FIFTHS            C IS CORRECT RESPONSE

                                                                          A      B    (C)      D      E      F      G      H      I      J   OMIT
    1ST +                                                 *   1ST       0      0     16      0      0      0      0      0      0      0      0
    2ND +                                             *       2ND       0      0     15      1      0      0      0      0      0      0      0
    3RD +                         *                           3RD       3      1      8      3      0      0      0      0      0      0      0
    4TH +                              *                      4TH       4      0     10      2      0      0      0      0      0      0      0
    5TH +                 *                                   5TH       7      2      6      1      0      0      0      0      0      0      0
        +----+----+----+----+----+----+----+----+----+----+
        0   10   20   30   40   50   60   70   80   90  100   PROP   0.18   0.04 (0.70)   0.09   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                              RPBI  -0.38  -0.19 (0.45)  -0.09   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```
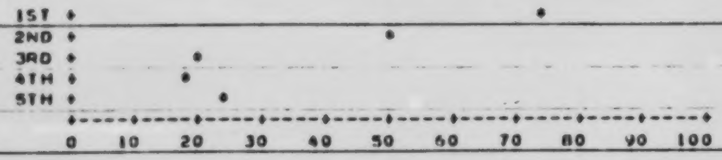
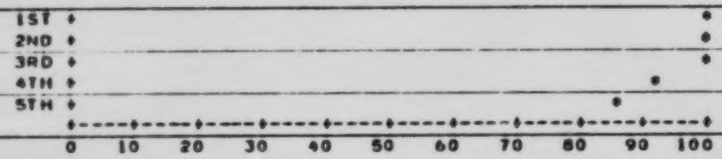

ITEM 41 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS D IS CORRECT RESPONSE

	A	B	C	(D)	E	F	G	H	I	J	OMIT
1ST	1	2	1	12	0	0	0	0	0	0	0
2ND	2	6	0	8	0	0	0	0	0	0	0
3RD	5	5	1	3	0	0	0	0	0	0	1
4TH	2	4	7	3	0	0	0	0	0	0	0
5TH	4	4	3	4	0	0	0	0	0	0	1
PROP	0.18	0.27	0.15	(0.38)	0.00	0.00	0.00	0.00	0.00	0.00	0.03
RPBI	-0.19	-0.05	-0.22	(0.38)	0.00	0.00	0.00	0.00	0.00	0.00	-0.08

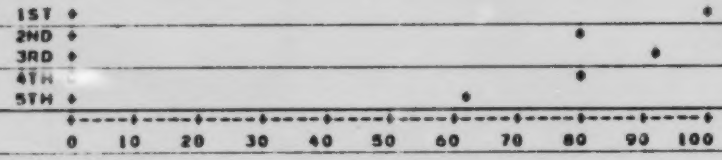
ITEM 42 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS D IS CORRECT RESPONSE

	A	B	C	(D)	E	F	G	H	I	J	OMIT
1ST	0	0	0	16	0	0	0	0	0	0	0
2ND	0	0	0	16	0	0	0	0	0	0	0
3RD	0	0	0	15	0	0	0	0	0	0	0
4TH	0	1	0	15	0	0	0	0	0	0	0
5TH	0	2	0	14	0	0	0	0	0	0	0
PROP	0.00	0.04	0.00	(0.96)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	0.00	-0.24	0.00	(0.24)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

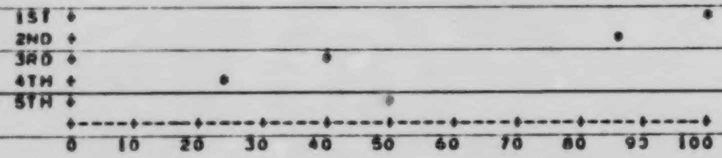
ITEM 43 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS A IS CORRECT RESPONSE

	(A)	B	C	D	E	F	G	H	I	J	OMIT
1ST	16	0	0	0	0	0	0	0	0	0	0
2ND	13	0	1	2	0	0	0	0	0	0	0
3RD	14	1	0	0	0	0	0	0	0	0	0
4TH	13	1	0	2	0	0	0	0	0	0	0
5TH	10	1	1	4	0	0	0	0	0	0	0
PROP	(0.84)	0.04	0.03	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	(0.29)	-0.15	-0.04	-0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00

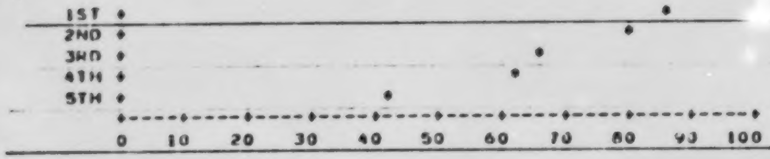
ITEM 44 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS D IS CORRECT RESPONSE

	A	B	C	(D)	E	F	G	H	I	J	OMIT
1ST	0	0	0	16	0	0	0	0	0	0	0
2ND	0	1	1	14	0	0	0	0	0	0	0
3RD	2	0	7	6	0	0	0	0	0	0	0
4TH	4	4	4	4	0	0	0	0	0	0	0
5TH	3	0	5	8	0	0	0	0	0	0	0
PROP	0.11	0.06	0.22	(0.61)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.34	-0.09	-0.28	(0.50)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

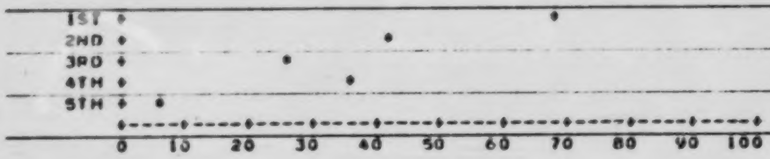
ITEM 45 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS D IS CORRECT RESPONSE

	A	B	C	(D)	E	F	G	H	I	J	OMIT
1ST	1	0	1	14	0	0	0	0	0	0	0
2ND	0	0	3	13	0	0	0	0	0	0	0
3RD	2	2	1	10	0	0	0	0	0	0	0
4TH	2	0	4	10	0	0	0	0	0	0	0
5TH	6	1	2	7	0	0	0	0	0	0	0
PROP	0.14	0.04	0.14	(0.68)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.22	-0.17	-0.08	(0.30)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

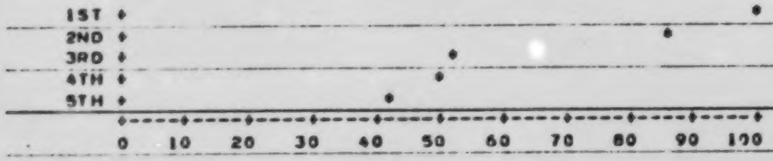
ITEM 46 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS A IS CORRECT RESPONSE

	(A)	B	C	D	E	F	G	H	I	J	OMIT
1ST	11	5	0	0	0	0	0	0	0	0	0
2ND	7	9	0	0	0	0	0	0	0	0	0
3RD	4	10	0	1	0	0	0	0	0	0	0
4TH	6	7	1	2	0	0	0	0	0	0	0
5TH	1	10	0	5	0	0	0	0	0	0	0
PROP	(0.37)	0.52	0.01	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	(0.43)	-0.18	-0.08	-0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00

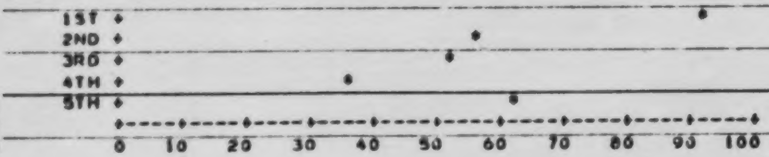
ITEM 47 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS D IS CORRECT RESPONSE

	A	B	C	(D)	E	F	G	H	I	J	OMIT
1ST	0	0	0	16	0	0	0	0	0	0	0
2ND	1	0	1	14	0	0	0	0	0	0	0
3RD	3	0	4	8	0	0	0	0	0	0	0
4TH	1	2	5	8	0	0	0	0	0	0	0
5TH	4	3	2	7	0	0	0	0	0	0	0
PROP	0.11	0.06	0.15	(0.67)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.27	-0.24	-0.18	(0.45)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ITEM 48 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS A IS CORRECT RESPONSE

	(A)	B	C	D	E	F	G	H	I	J	OMIT
1ST	15	0	1	0	0	0	0	0	0	0	0
2ND	9	5	1	1	0	0	0	0	0	0	0
3RD	8	1	4	2	0	0	0	0	0	0	0
4TH	6	1	5	4	0	0	0	0	0	0	0
5TH	10	2	2	2	0	0	0	0	0	0	0
PROP	(0.81)	0.11	0.16	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	(0.23)	-0.06	-0.11	-0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00

PRINTED IN U.S.A.

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ITEM  49     PERCENT OF CORRECT RESPONSE BY FIFTHS       MATRIX OF RESPONSES BY FIFTHS          D IS CORRECT RESPONSE

  1ST +                                    *
  2ND +                                    *
  3RD +                                   *
  4TH +                           *
  5TH +                    *
      +----+----+----+----+----+----+----+----+----+----+
      0    10   20   30   40   50   60   70   80   90   100

                 A      B      C     (D)     E      F      G      H      I      J   OMIT
        1ST      4      0      0     12      0      0      0      0      0      0      0
        2ND      3      0      1     12      0      0      0      0      0      0      0
        3RD      3      0      1     11      0      0      0      0      0      0      0
        4TH      7      0      0      9      0      0      0      0      0      0      0
        5TH      7      1      1      7      0      0      0      0      0      0      0

        PROP   0.30   0.01   0.04 (0.65)  0.00   0.00   0.00   0.00   0.00   0.00   0.00
        RPBI  -0.13  -0.29  -0.04 (0.20)  0.00   0.00   0.00   0.00   0.00   0.00   0.00


ITEM  50     PERCENT OF CORRECT RESPONSE BY FIFTHS       MATRIX OF RESPONSES BY FIFTHS          A IS CORRECT RESPONSE

  1ST +                                                 *
  2ND +                                              *
  3RD +                                *
  4TH +                              *
  5TH +                              *
      +----+----+----+----+----+----+----+----+----+----+
      0    10   20   30   40   50   60   70   80   90   100

                (A)     B      C      D      E      F      G      H      I      J   OMIT
        1ST     16      0      0      0      0      0      0      0      0      0      0
        2ND     15      1      0      0      0      0      0      0      0      0      0
        3RD     10      0      2      3      0      0      0      0      0      0      0
        4TH     10      0      1      5      0      0      0      0      0      0      0
        5TH     10      2      3      1      0      0      0      0      0      0      0

        PROP  (0.77)  0.04   0.08   0.11   0.00   0.00   0.00   0.00   0.00   0.00   0.00
        RPBI  (0.41) -0.20  -0.31  -0.17   0.00   0.00   0.00   0.00   0.00   0.00   0.00


ITEM  51     PERCENT OF CORRECT RESPONSE BY FIFTHS       MATRIX OF RESPONSES BY FIFTHS          C IS CORRECT RESPONSE

  1ST +                                       *
  2ND +                              *
  3RD +                      *
  4TH +                 *
  5TH +                 *
      +----+----+----+----+----+----+----+----+----+----+
      0    10   20   30   40   50   60   70   80   90   100

                 A      B     (C)     D      E      F      G      H      I      J   OMIT
        1ST      1      2     13      0      0      0      0      0      0      0      0
        2ND      2      4     10      0      0      0      0      0      0      0      0
        3RD      0      7      7      1      0      0      0      0      0      0      0
        4TH      1      7      6      2      0      0      0      0      0      0      0
        5TH      2      4      6      4      0      0      0      0      0      0      0

        PROP   0.08   0.30  (0.53)  0.09   0.00   0.00   0.00   0.00   0.00   0.00   0.00
        RPBI  -0.03  -0.12  (0.28) -0.28   0.00   0.00   0.00   0.00   0.00   0.00   0.00


ITEM  52     PERCENT OF CORRECT RESPONSE BY FIFTHS       MATRIX OF RESPONSES BY FIFTHS          B IS CORRECT RESPONSE

  1ST +                           *
  2ND +           *
  3RD +                      *
  4TH +                 *
  5TH +           *
      +----+----+----+----+----+----+----+----+----+----+
      0    10   20   30   40   50   60   70   80   90   100

                 A     (B)     C      D      E      F      G      H      I      J   OMIT
        1ST      0      9      0      7      0      0      0      0      0      0      0
        2ND      5      4      4      3      0      0      0      0      0      0      0
        3RD      2      7      2      4      0      0      0      0      0      0      0
        4TH      1      6      7      2      0      0      0      0      0      0      0
        5TH      2      4      7      3      0      0      0      0      0      0      0

        PROP   0.13  (0.38)  0.25   0.24   0.00   0.00   0.00   0.00   0.00   0.00   0.00
        RPBI  -0.08  (0.14) -0.32   0.22   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

```
ITEM  53      PERCENT OF CORRECT RESPONSE BY FIFTHS           MATRIX OF RESPONSES BY FIFTHS                    B IS CORRECT RESPONSE

                                                                         A    (B)      C      D      E      F      G      H      I      J   OMIT
    1ST +                                              *      1ST        1     15      0      0      0      0      0      0      0      0      0
    2ND +                              *                      2ND        4     10      2      0      0      0      0      0      0      0      0
    3RD +                          *                          3RD        5      8      2      0      0      0      0      0      0      0      0
    4TH +                     *                               4TH        2      7      7      0      0      0      0      0      0      0      0
    5TH +               *                                     5TH        6      5      5      0      0      0      0      0      0      0      0
        +----+----+----+----+----+----+----+----+----+----+
        0   10   20   30   40   50   60   70   80   90  100   PROP    0.23 (0.57)   0.20   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                              RPBI   -0.16 (0.39)-0.31   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00

ITEM  54      PERCENT OF CORRECT RESPONSE BY FIFTHS           MATRIX OF RESPONSES BY FIFTHS                    C IS CORRECT RESPONSE

                                                                         A      B    (C)      D      E      F      G      H      I      J   OMIT
    1ST +                                           *         1ST        2      0     14      0      0      0      0      0      0      0      0
    2ND +                                 *                   2ND        2      0     11      3      0      0      0      0      0      0      0
    3RD +      *                                              3RD        8      3      2      2      0      0      0      0      0      0      0
    4TH +                           *                         4TH        3      2      9      2      0      0      0      0      0      0      0
    5TH +                        *                            5TH        4      1      8      3      0      0      0      0      0      0      0
        +----+----+----+----+----+----+----+----+----+----+
        0   10   20   30   40   50   60   70   80   90  100   PROP    0.24   0.08 (0.56)   0.13   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                              RPBI   -0.12  -0.17 (0.30)-0.16   0.00   0.00   0.00   0.00   0.00   0.00   0.00

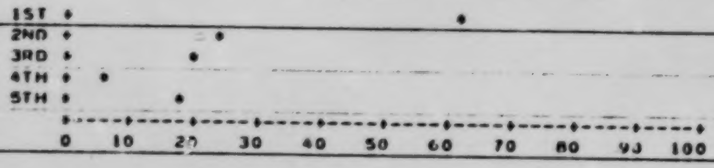
ITEM  55      PERCENT OF CORRECT RESPONSE BY FIFTHS           MATRIX OF RESPONSES BY FIFTHS                    A IS CORRECT RESPONSE

                                                                       (A)      B      C      D      E      F      G      H      I      J   OMIT
    1ST +                                           *         1ST       14      2      0      0      0      0      0      0      0      0      0
    2ND +                                           *         2ND       14      1      0      1      0      0      0      0      0      0      0
    3RD +                             *                       3RD        9      2      1      3      0      0      0      0      0      0      0
    4TH +                              *                      4TH       10      2      3      1      0      0      0      0      0      0      0
    5TH +                                       *             5TH       13      1      1      1      0      0      0      0      0      0      0
        +----+----+----+----+----+----+----+----+----+----+
        0   10   20   30   40   50   60   70   80   90  100   PROP  (0.76)   0.10   0.06   0.08   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                              RPBI  (0.14)   0.00  -0.16  -0.09   0.00   0.00   0.00   0.00   0.00   0.00   0.00

ITEM  56      PERCENT OF CORRECT RESPONSE BY FIFTHS           MATRIX OF RESPONSES BY FIFTHS                    B IS CORRECT RESPONSE

                                                                         A    (B)      C      D      E      F      G      H      I      J   OMIT
    1ST +                                           *         1ST        0     14      1      1      0      0      0      0      0      0      0
    2ND +                                    *                2ND        0     12      3      1      0      0      0      0      0      0      0
    3RD +                                       *             3RD        1     12      1      1      0      0      0      0      0      0      0
    4TH +                                       *             4TH        0     13      1      2      0      0      0      0      0      0      0
    5TH +                              *                      5TH        0     10      5      1      0      0      0      0      0      0      0
        +----+----+----+----+----+----+----+----+----+----+
        0   10   20   30   40   50   60   70   80   90  100   PROP    0.01 (0.77)   0.14   0.08   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                              RPBI   -0.01 (0.19)-0.17  -0.07   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 57   PERCENT OF CORRECT RESPONSE BY FIFTHS

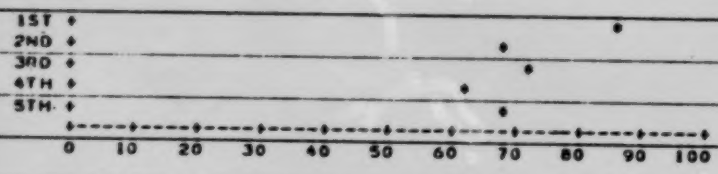


```
MATRIX OF RESPONSES BY FIFTHS                   C IS CORRECT RESPONSE

          A      B     (C)     D      E      F      G      H      I      J   OMIT
 1ST      0      0     10      6      0      0      0      0      0      0      0
 2ND      0      0      4     12      0      0      0      0      0      0      0
 3RD      0      1      3     11      0      0      0      0      0      0      0
 4TH      0      3      1     12      0      0      0      0      0      0      0
 5TH      2      3      3      8      0      0      0      0      0      0      0

PROP   0.03   0.09 (0.27)  0.62   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI  -0.29  -0.22 (0.38)-0.13   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 58   PERCENT OF CORRECT RESPONSE BY FIFTHS

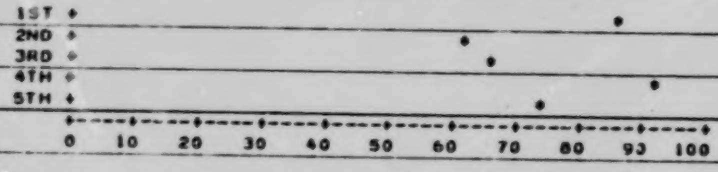


```
MATRIX OF RESPONSES BY FIFTHS                   D IS CORRECT RESPONSE

          A      B      C     (D)     E      F      G      H      I      J   OMIT
 1ST      1      1      0     14      0      0      0      0      0      0      0
 2ND      3      1      1     11      0      0      0      0      0      0      0
 3RD      1      2      1     11      0      0      0      0      0      0      0
 4TH      0      5      1     10      0      0      0      0      0      0      0
 5TH      0      4      1     11      0      0      0      0      0      0      0

PROP   0.06   0.16   0.05 (0.72)  0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI   0.19  -0.29  -0.08 (0.18)  0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 59   PERCENT OF CORRECT RESPONSE BY FIFTHS

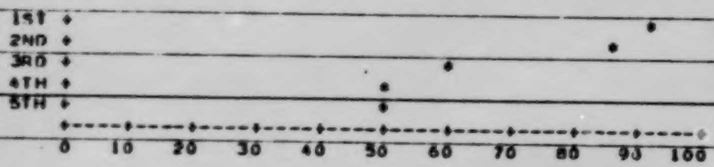


```
MATRIX OF RESPONSES BY FIFTHS                   D IS CORRECT RESPONSE

          A      B      C     (D)     E      F      G      H      I      J   OMIT
 1ST      0      1      1     14      0      0      0      0      0      0      0
 2ND      0      1      5     10      0      0      0      0      0      0      0
 3RD      0      4      1     10      0      0      0      0      0      0      0
 4TH      0      0      1     15      0      0      0      0      0      0      0
 5TH      0      2      2     12      0      0      0      0      0      0      0

PROP   0.00   0.10   0.13 (0.77)  0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI   0.00  -0.05  -0.01 (0.05)  0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 60   PERCENT OF CORRECT RESPONSE BY FIFTHS



```
MATRIX OF RESPONSES BY FIFTHS                   C IS CORRECT RESPONSE

          A      B     (C)     D      E      F      G      H      I      J   OMIT
 1ST      0      1     15      0      0      0      0      0      0      0      0
 2ND      1      1     14      0      0      0      0      0      0      0      0
 3RD      4      2      9      0      0      0      0      0      0      0      0
 4TH      4      3      8      1      0      0      0      0      0      0      0
 5TH      0      7      8      1      0      0      0      0      0      0      0

PROP   0.11   0.18 (0.68)  0.03   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI  -0.12  -0.30 (0.42)-0.27   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

```
   ITEM  61      PERCENT OF CORRECT RESPONSE BY FIFTHS                       MATRIX OF RESPONSES BY FIFTHS                    B IS CORRECT RESPONSE

                                                                                    A     (B)       C       D       E       F       G       H       I       J    OMIT
        1ST +                                                      *         1ST       0      15       0       1       0       0       0       0       0       0       0
        2ND +                                                           *    2ND       0      16       0       0       0       0       0       0       0       0       0
        3RD +                                                  *             3RD       0      13       0       2       0       0       0       0       0       0       0
        4TH +                                                  *             4TH       3      14       1       1       0       0       0       0       0       0       0
        5TH +                                           *                    5TH       2      12       1       1       0       0       0       0       0       0       0
            +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
            0     10    20    30    40    50    60    70    80    90    100  PROP    0.03  (0.87)    0.03    0.06    0.00    0.00    0.00    0.00    0.00    0.00    0.00
                                                                             RPBI   -0.32  (0.25)   -0.12   -0.04    0.00    0.00    0.00    0.00    0.00    0.00    0.00

   ITEM  62      PERCENT OF CORRECT RESPONSE BY FIFTHS                       MATRIX OF RESPONSES BY FIFTHS                    C IS CORRECT RESPONSE

                                                                                    A       B     (C)       D       E       F       G       H       I       J    OMIT
        1ST +                                                           *    1ST       0       0      16       0       0       0       0       0       0       0       0
        2ND +                                                      *         2ND       1       0      15       0       0       0       0       0       0       0       0
        3RD +                                                           *    3RD       0       0      15       0       0       0       0       0       0       0       0
        4TH +                                                  *             4TH       1       0      14       1       0       0       0       0       0       0       0
        5TH +                                 *                              5TH       3       3       9       1       0       0       0       0       0       0       0
            +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
            0     10    20    30    40    50    60    70    80    90    100  PROP    0.06    0.04  (0.87)    0.03    0.00    0.00    0.00    0.00    0.00    0.00    0.00
                                                                             RPBI   -0.19   -0.35  (0.40)   -0.13    0.00    0.00    0.00    0.00    0.00    0.00    0.00

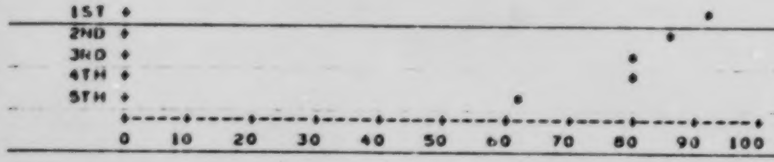
   ITEM  63      PERCENT OF CORRECT RESPONSE BY FIFTHS                       MATRIX OF RESPONSES BY FIFTHS                    D IS CORRECT RESPONSE

                                                                                    A       B       C     (D)       E       F       G       H       I       J    OMIT
        1ST +                                                           *    1ST       0       0       0      16       0       0       0       0       0       0       0
        2ND +                                                           *    2ND       0       0       0      16       0       0       0       0       0       0       0
        3RD +                                                           *    3RD       0       0       0      15       0       0       0       0       0       0       0
        4TH +                                                      *         4TH       0       1       0      15       0       0       0       0       0       0       0
        5TH +                                                  *             5TH       2       0       0      14       0       0       0       0       0       0       0
            +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
            0     10    20    30    40    50    60    70    80    90    100  PROP    0.03    0.01    0.00  (0.96)    0.00    0.00    0.00    0.00    0.00    0.00    0.00
                                                                             RPBI   -0.30   -0.04    0.00  (0.27)    0.00    0.00    0.00    0.00    0.00    0.00    0.00

   ITEM  64      PERCENT OF CORRECT RESPONSE BY FIFTHS                       MATRIX OF RESPONSES BY FIFTHS                    A IS CORRECT RESPONSE

                                                                                  (A)       B       C       D       E       F       G       H       I       J    OMIT
        1ST +                                                  *             1ST      14       0       2       0       0       0       0       0       0       0       0
        2ND +                                    *                           2ND      10       0       6       0       0       0       0       0       0       0       0
        3RD +                                          *                     3RD      11       0       3       1       0       0       0       0       0       0       0
        4TH +                                 *                              4TH       9       1       5       1       0       0       0       0       0       0       0
        5TH +                 *                                              5TH       5       1      10       0       0       0       0       0       0       0       0
            +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
            0     10    20    30    40    50    60    70    80    90    100  PROP  (0.62)    0.03    0.33    0.03    0.00    0.00    0.00    0.00    0.00    0.00    0.00
                                                                             RPBI  (0.37)   -0.14   -0.31   -0.06    0.00    0.00    0.00    0.00    0.00    0.00    0.00
```

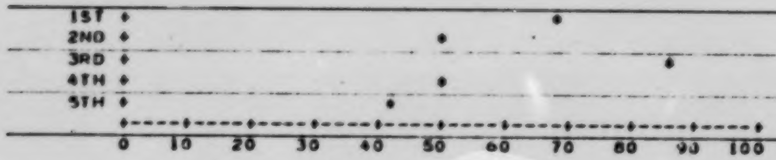
ITEM 65 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS B IS CORRECT RESPONSE

	A	(B)	C	D	E	F	G	H	I	J	OMIT
1ST	0	15	1	0	0	0	0	0	0	0	0
2ND	0	14	2	0	0	0	0	0	0	0	0
3RD	2	12	1	0	0	0	0	0	0	0	0
4TH	2	13	1	0	0	0	0	0	0	0	0
5TH	4	10	2	0	0	0	0	0	0	0	0
PROP	0.10	(0.81)	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.32	(0.28)	-0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

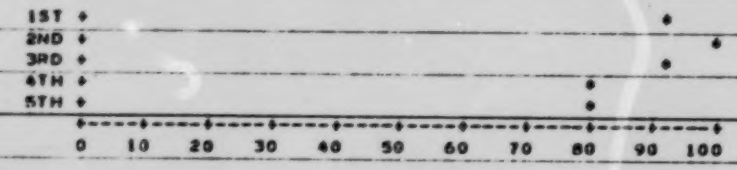
ITEM 66 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS D IS CORRECT RESPONSE

	A	B	C	(D)	E	F	G	H	I	J	OMIT
1ST	4	0	1	11	0	0	0	0	0	0	0
2ND	5	1	2	8	0	0	0	0	0	0	0
3RD	0	0	2	13	0	0	0	0	0	0	0
4TH	3	3	2	8	0	0	0	0	0	0	0
5TH	4	1	4	7	0	0	0	0	0	0	0
PROP	0.20	0.06	0.14	(0.59)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	0.01	-0.12	-0.14	(0.15)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

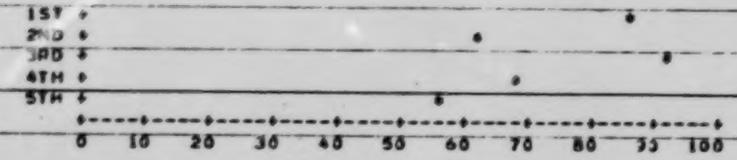
ITEM 67 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS B IS CORRECT RESPONSE

	A	(B)	C	D	E	F	G	H	I	J	OMIT
1ST	0	15	0	1	0	0	0	0	0	0	0
2ND	0	16	0	0	0	0	0	0	0	0	0
3RD	1	14	0	0	0	0	0	0	0	0	0
4TH	2	13	1	0	0	0	0	0	0	0	0
5TH	3	13	0	0	0	0	0	0	0	0	0
PROP	0.08	(0.90)	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.28	(0.22)	-0.07	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ITEM 68 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS C IS CORRECT RESPONSE

	A	B	(C)	D	E	F	G	H	I	J	OMIT
1ST	1	0	14	1	0	0	0	0	0	0	0
2ND	0	1	10	5	0	0	0	0	0	0	0
3RD	0	1	14	0	0	0	0	0	0	0	0
4TH	0	1	11	4	0	0	0	0	0	0	0
5TH	3	0	9	4	0	0	0	0	0	0	0
PROP	0.05	0.04	(0.73)	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.13	-0.05	(0.18)	-0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00

422

423

```
ITEM  69     PERCENT OF CORRECT RESPONSE BY FIFTHS

  1ST +                                                 *
  2ND +                                             *
  3RD +                                             *
  4TH +                                 *
  5TH +                        *
      +----+----+----+----+----+----+----+----+----+----+
      0   10   20   30   40   50   60   70   80   90  100

MATRIX OF RESPONSES BY FIFTHS                D IS CORRECT RESPONSE

            A      B      C    (D)      E      F      G      H      I      J   OMIT
1ST         0      0      0     16      0      0      0      0      0      0      0
2ND         1      0      0     15      0      0      0      0      0      0      0
3RD         1      0      0     14      0      0      0      0      0      0      0
4TH         3      1      1     11      0      0      0      0      0      0      0
5TH         4      3      1      8      0      0      0      0      0      0      0

PROP     0.11   0.05   0.03 (0.81)   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI    -0.25  -0.32  -0.23 (0.46)   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

```
ITEM  70     PERCENT OF CORRECT RESPONSE BY FIFTHS

  1ST +                                             *
  2ND +                                          *
  3RD +                                          *
  4TH +                                 *
  5TH +                        *
      +----+----+----+----+----+----+----+----+----+----+
      0   10   20   30   40   50   60   70   80   90  100

MATRIX OF RESPONSES BY FIFTHS                B IS CORRECT RESPONSE

            A    (B)      C      D      E      F      G      H      I      J   OMIT
1ST         1     15      0      0      0      0      0      0      0      0      0
2ND         2     14      0      0      0      0      0      0      0      0      0
3RD         2     13      0      0      0      0      0      0      0      0      0
4TH         2     11      0      2      0      0      0      0      0      0      1
5TH         8      8      0      0      0      0      0      0      0      0      0

PROP     0.19 (0.77)   0.00   0.03   0.00   0.00   0.00   0.00   0.00   0.00   0.01
RPBI    -0.32 (0.33)   0.00  -0.07   0.00   0.00   0.00   0.00   0.00   0.00  -0.04
```

```
ITEM  71     PERCENT OF CORRECT RESPONSE BY FIFTHS

  1ST +                                                 *
  2ND +                                                 *
  3RD +                                                 *
  4TH +                                                 *
  5TH +                                       *
      +----+----+----+----+----+----+----+----+----+----+
      0   10   20   30   40   50   60   70   80   90  100

MATRIX OF RESPONSES BY FIFTHS                C IS CORRECT RESPONSE

            A      B    (C)      D      E      F      G      H      I      J   OMIT
1ST         0      0     16      0      0      0      0      0      0      0      0
2ND         0      0     16      0      0      0      0      0      0      0      0
3RD         0      0     15      0      0      0      0      0      0      0      0
4TH         0      0     16      0      0      0      0      0      0      0      0
5TH         2      1     13      0      0      0      0      0      0      0      0

PROP     0.03   0.01 (0.96)   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI    -0.24  -0.19 (0.31)   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

```
ITEM  72     PERCENT OF CORRECT RESPONSE BY FIFTHS

  1ST +                           *
  2ND +                           *
  3RD +                                          *
  4TH +                    *
  5TH +                        *
      +----+----+----+----+----+----+----+----+----+----+
      0   10   20   30   40   50   60   70   80   90  100

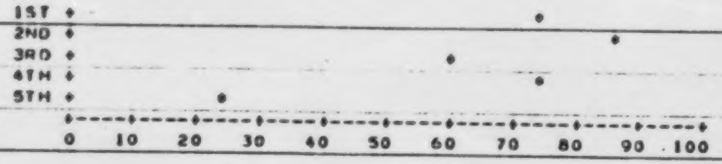
MATRIX OF RESPONSES BY FIFTHS                A IS CORRECT RESPONSE

          (A)      B      C      D      E      F      G      H      I      J   OMIT
1ST         9      3      3      1      0      0      0      0      0      0      0
2ND         9      2      2      3      0      0      0      0      0      0      0
3RD        13      0      2      0      0      0      0      0      0      0      0
4TH         7      5      1      3      0      0      0      0      0 [illegible]  0
5TH         8      3      2      3      0      0      0      0      0 [illegible]  0

PROP   (0.58)   0.16   0.13   0.13   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI   (0.02)  -0.03   0.15  -0.14   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

PRINTED IN U.S.A.

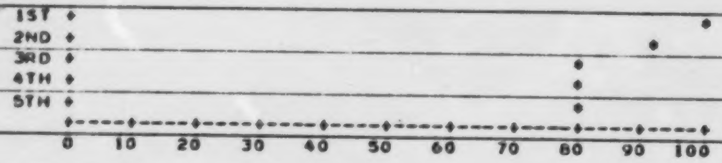
ITEM 73 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS D IS CORRECT RESPONSE

	A	B	C	(D)	E	F	G	H	I	J	OMIT
1ST	1	3	0	12	0	0	0	0	0	0	0
2ND	2	0	0	14	0	0	0	0	0	0	0
3RD	1	5	0	9	0	0	0	0	0	0	0
4TH	1	2	1	12	0	0	0	0	0	0	0
5TH	4	3	5	4	0	0	0	0	0	0	0
PROP	0.11	0.16	0.08	(0.65)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.11	-0.09	-0.42	(0.37)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

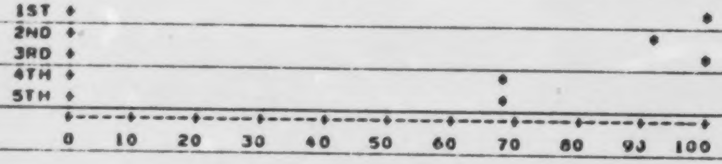
ITEM 74 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS C IS CORRECT RESPONSE

	A	B	(C)	D	E	F	G	H	I	J	OMIT
1ST	0	0	16	0	0	0	0	0	0	0	0
2ND	0	1	15	0	0	0	0	0	0	0	0
3RD	2	0	12	1	0	0	0	0	0	0	0
4TH	2	1	13	0	0	0	0	0	0	0	0
5TH	3	0	13	0	0	0	0	0	0	0	0
PROP	0.09	0.03	(0.87)	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.20	-0.01	(0.18)	-0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

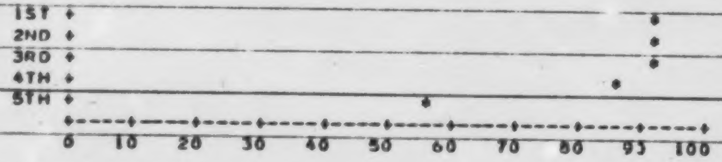
ITEM 75 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS C IS CORRECT RESPONSE

	A	B	(C)	D	E	F	G	H	I	J	OMIT
1ST	0	0	16	0	0	0	0	0	0	0	0
2ND	0	1	15	0	0	0	0	0	0	0	0
3RD	0	0	15	0	0	0	0	0	0	0	0
4TH	1	3	11	1	0	0	0	0	0	0	0
5TH	0	4	11	1	0	0	0	0	0	0	0
PROP	0.01	0.10	(0.86)	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.08	-0.26	(0.34)	-0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00

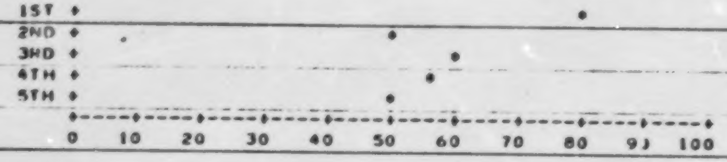
ITEM 76 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS D IS CORRECT RESPONSE

	A	B	C	(D)	E	F	G	H	I	J	OMIT
1ST	1	0	0	15	0	0	0	0	0	0	0
2ND	0	1	0	15	0	0	0	0	0	0	0
3RD	1	0	0	14	0	0	0	0	0	0	0
4TH	2	0	0	14	0	0	0	0	0	0	0
5TH	6	0	1	9	0	0	0	0	0	0	0
PROP	0.13	0.01	0.01	(0.85)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.37	0.03	-0.10	(0.37)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ITEM 77 PERCENT OF CORRECT RESPONSE BY FIFTHS

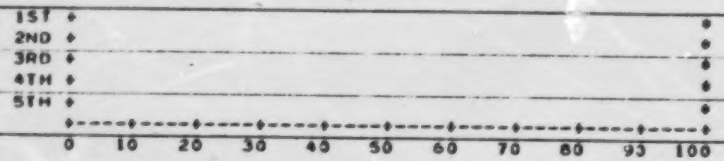


```
MATRIX OF RESPONSES BY FIFTHS                     C IS CORRECT RESPONSE

          A      B     (C)     D      E      F      G      H      I      J   OMIT
 1ST      1      0     13      2      0      0      0      0      0      0      0
 2ND      1      3      8      4      0      0      0      0      0      0      0
 3RD      1      2      9      3      0      0      0      0      0      0      0
 4TH      0      1      9      6      0      0      0      0      0      0      0
 5TH      1      3      8      4      0      0      0      0      0      0      0

PROP   0.05   0.11 (0.59) 0.24   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI   0.01  -0.11 (0.18)-0.13   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 78 PERCENT OF CORRECT RESPONSE BY FIFTHS

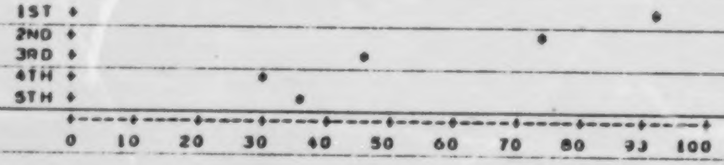


```
MATRIX OF RESPONSES BY FIFTHS                     D IS CORRECT RESPONSE

          A      B      C     (D)     E      F      G      H      I      J   OMIT
 1ST      0      0      0     16      0      0      0      0      0      0      0
 2ND      0      0      0     16      0      0      0      0      0      0      0
 3RD      0      0      0     15      0      0      0      0      0      0      0
 4TH      0      0      0     16      0      0      0      0      0      0      0
 5TH      0      0      0     16      0      0      0      0      0      0      0

PROP   0.00   0.00   0.00 (1.00) 0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI   0.00   0.00   0.00 (0.00) 0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 79 PERCENT OF CORRECT RESPONSE BY FIFTHS

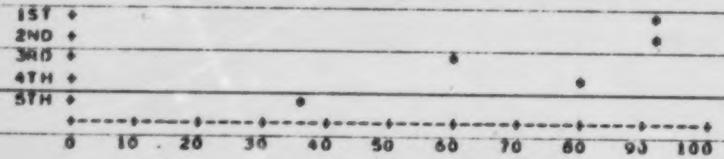


```
MATRIX OF RESPONSES BY FIFTHS                     C IS CORRECT RESPONSE

          A      B     (C)     D      E      F      G      H      I      J   OMIT
 1ST      1      0     15      0      0      0      0      0      0      0      0
 2ND      2      0     12      2      0      0      0      0      0      0      0
 3RD      5      1      7      2      0      0      0      0      0      0      0
 4TH      6      2      5      3      0      0      0      0      0      0      0
 5TH      5      1      6      4      0      0      0      0      0      0      0

PROP   0.24   0.05 (0.57) 0.14   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI  -0.21  -0.13 (0.39)-0.22   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 80 PERCENT OF CORRECT RESPONSE BY FIFTHS



```
MATRIX OF RESPONSES BY FIFTHS                     C IS CORRECT RESPONSE

          A      B     (C)     D      E      F      G      H      I      J   OMIT
 1ST      1      0     15      0      0      0      0      0      0      0      0
 2ND      1      0     15      0      0      0      0      0      0      0      0
 3RD      4      0      9      2      0      0      0      0      0      0      0
 4TH      2      0     13      1      0      0      0      0      0      0      0
 5TH      3      1      6      6      0      0      0      0      0      0      0

PROP   0.14   0.01 (0.73) 0.11   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI  -0.16  -0.10 (0.39)-0.33   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

```
ITEM  81      PERCENT OF CORRECT RESPONSE BY FIFTHS                               MATRIX OF RESPONSES BY FIFTHS                 B IS CORRECT RESPONSE

                                                                                          A    (B)      C      D      E      F      G      H      I      J   OMIT
   1ST +                                                            *             1ST       0     14      1      1      0      0      0      0      0      0      0
   2ND +                                                                *         2ND       0     15      1      0      0      0      0      0      0      0      0
   3RD +                                                            *             3RD       1     13      0      1      0      0      0      0      0      0      0
   4TH +                                                                *         4TH       0     15      1      0      0      0      0      0      0      0      0
   5TH +                                   *                                      5TH       3      8      2      3      0      0      0      0      0      0      0
       +------+------+------+------+------+------+------+------+------+------+
       0     10     20     30     40     50     60     70     80     93    100    PROP   0.05 (0.82)   0.06   0.06   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                                                  RPBI  -0.29 (0.33)-0.13    -0.12   0.00   0.00   0.00   0.00   0.00   0.00   0.00

ITEM  82      PERCENT OF CORRECT RESPONSE BY FIFTHS                               MATRIX OF RESPONSES BY FIFTHS                 D IS CORRECT RESPONSE

                                                                                          A      B      C    (D)      E      F      G      H      I      J   OMIT
   1ST +                                                                      *   1ST       0      0      0     16      0      0      0      0      0      0      0
   2ND +                                                                      *   2ND       0      0      0     16      0      0      0      0      0      0      0
   3RD +                                                                *         3RD       0      0      1     14      0      0      0      0      0      0      0
   4TH +                                                    *                     4TH       0      1      3     12      0      0      0      0      0      0      0
   5TH +                                                            *             5TH       1      1      0     14      0      0      0      0      0      0      0
       +------+------+------+------+------+------+------+------+------+------+
       0     10     20     30     40     50     60     70     80     93    100    PROP   0.01   0.03   0.05 (0.91)   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                                                  RPBI  -0.19  -0.10  -0.12 (0.22)   0.00   0.00   0.00   0.00   0.00   0.00   0.00

ITEM  83      PERCENT OF CORRECT RESPONSE BY FIFTHS                               MATRIX OF RESPONSES BY FIFTHS                 A IS CORRECT RESPONSE

                                                                                        (A)      B      C      D      E      F      G      H      I      J   OMIT
   1ST +                                                                *         1ST      15      1      0      0      0      0      0      0      0      0      0
   2ND +                                                                *         2ND      15      1      0      0      0      0      0      0      0      0      0
   3RD +                                                                      *   3RD      15      0      0      0      0      0      0      0      0      0      0
   4TH +                                                                *         4TH      15      1      0      0      0      0      0      0      0      0      0
   5TH +                                                                *         5TH      15      0      1      0      0      0      0      0      0      0      0
       +------+------+------+------+------+------+------+------+------+------+
       0     10     20     30     40     50     60     70     80     90    100    PROP (0.95)   0.04   0.01   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                                                  RPBI (0.04)   0.09  -0.24   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00

ITEM  84      PERCENT OF CORRECT RESPONSE BY FIFTHS                               MATRIX OF RESPONSES BY FIFTHS                 C IS CORRECT RESPONSE

                                                                                          A      B    (C)      D      E      F      G      H      I      J   OMIT
   1ST +                                                *                         1ST       1      1     11      3      0      0      0      0      0      0      0
   2ND +                                           *                              2ND       0      1     10      5      0      0      0      0      0      0      0
   3RD +                            *                                             3RD       3      2      6      4      0      0      0      0      0      0      0
   4TH +                         *                                                4TH       1      6      6      3      0      0      0      0      0      0      0
   5TH +                 *                                                        5TH       6      1      4      5      0      0      0      0      0      0      0
       +------+------+------+------+------+------+------+------+------+------+
       0     10     20     30     40     50     60     70     80     90    100    PROP   0.14   0.14 (0.47)   0.25   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                                                  RPBI  -0.34  -0.12 (0.33)-0.02     0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

```
ITEM  85      PERCENT OF CORRECT RESPONSE BY FIFTHS             MATRIX OF RESPONSES BY FIFTHS                A IS CORRECT RESPONSE

                                                                        (A)      B      C      D      E      F      G      H      I      J   OMIT
      1ST +                                                 *   1ST      16      0      0      0      0      0      0      0      0      0      0
      2ND +                                             *       2ND      15      0      1      0      0      0      0      0      0      0      0
      3RD +                                             *       3RD      14      0      1      0      0      0      0      0      0      0      0
      4TH +                                    *                4TH      12      2      2      0      0      0      0      0      0      0      0
      5TH +                                          *          5TH      14      1      0      1      0      0      0      0      0      0      0
          +----+----+----+----+----+----+----+----+----+----+
          0    10   20   30   40   50   60   70   80   90   100 PROP (0.90)   0.04   0.05   0.01   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                                RPBI (0.29)  -0.25  -0.06  -0.24   0.00   0.00   0.00   0.00   0.00   0.00   0.00

ITEM  86      PERCENT OF CORRECT RESPONSE BY FIFTHS             MATRIX OF RESPONSES BY FIFTHS                C IS CORRECT RESPONSE

                                                                          A      B    (C)      D      E      F      G      H      I      J   OMIT
      1ST +                                                 *   1ST       0      0     16      0      0      0      0      0      0      0      0
      2ND +                                                 *   2ND       0      0     16      0      0      0      0      0      0      0      0
      3RD +                                             *       3RD       1      0     14      0      0      0      0      0      0      0      0
      4TH +                                                 *   4TH       0      0     16      0      0      0      0      0      0      0      0
      5TH +                                             *       5TH       1      0     15      0      0      0      0      0      0      0      0
          +----+----+----+----+----+----+----+----+----+----+
          0    10   20   30   40   50   60   70   80   90   100 PROP   0.03   0.00 (0.97)   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                                RPBI  -0.08   0.00 (0.08)   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00

ITEM  87      PERCENT OF CORRECT RESPONSE BY FIFTHS             MATRIX OF RESPONSES BY FIFTHS                D IS CORRECT RESPONSE

                                                                          A      B      C    (D)      E      F      G      H      I      J   OMIT
      1ST +                                                 *   1ST       0      0      0     16      0      0      0      0      0      0      0
      2ND +                                                 *   2ND       0      0      0     16      0      0      0      0      0      0      0
      3RD +                                                 *   3RD       0      0      0     15      0      0      0      0      0      0      0
      4TH +                                             *       4TH       0      1      0     15      0      0      0      0      0      0      0
      5TH +                                                 *   5TH       0      0      0     16      0      0      0      0      0      0      0
          +----+----+----+----+----+----+----+----+----+----+
          0    10   20   30   40   50   60   70   80   90   100 PROP   0.00   0.01   0.00 (0.99)   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                                RPBI   0.00  -0.08   0.00 (0.08)   0.00   0.00   0.00   0.00   0.00   0.00   0.00

ITEM  88      PERCENT OF CORRECT RESPONSE BY FIFTHS             MATRIX OF RESPONSES BY FIFTHS                D IS CORRECT RESPONSE

                                                                          A      B      C    (D)      E      F      G      H      I      J   OMIT
      1ST +                                          *          1ST       1      0      1     14      0      0      0      0      0      0      0
      2ND +                                 *                   2ND       0      0      5     11      0      0      0      0      0      0      0
      3RD +                                       *             3RD       1      0      2     12      0      0      0      0      0      0      0
      4TH +                                 *                   4TH       1      2      2     11      0      0      0      0      0      0      0
      5TH +                                                 *   5TH       0      0      0     16      0      0      0      0      0      0      0
          +----+----+----+----+----+----+----+----+----+----+
          0    10   20   30   40   50   60   70   80   90   100 PROP   0.04   0.03   0.13 (0.81)   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                                RPBI   0.07  -0.10   0.10 (0.08)   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

```
ITEM  89     PERCENT OF CORRECT RESPONSE BY FIFTHS            MATRIX OF RESPONSES BY FIFTHS                 B IS CORRECT RESPONSE

     1ST +                                                       *               A    (B)     C     D     E     F     G     H     I     J  OMIT
     2ND +                                                           *     1ST   0     15     1     0     0     0     0     0     0     0     0
     3RD +                                                   *             2ND   0     16     0     0     0     0     0     0     0     0     0
     4TH +                                                       *         3RD   1     13     1     0     0     0     0     0     0     0     0
     5TH +                                 *                               4TH   0     15     1     0     0     0     0     0     0     0     0
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+     5TH   2      9     3     2     0     0     0     0     0     0     0
         0     10    20    30    40    50    60    70    80    90   100
                                                                          PROP  0.04 (0.86) 0.08  0.03  0.00  0.00  0.00  0.00  0.00  0.00  0.00
                                                                          RPBI -0.19 (0.36)-0.24 -0.16  0.00  0.00  0.00  0.00  0.00  0.00  0.00
```

```
ITEM  90     PERCENT OF CORRECT RESPONSE BY FIFTHS            MATRIX OF RESPONSES BY FIFTHS                 D IS CORRECT RESPONSE

                                                                                 A      B     C    (D)    E     F     G     H     I     J  OMIT
     1ST +                                                           *     1ST   0      0     0    16     0     0     0     0     0     0     0
     2ND +                                            *                    2ND   1      1     2    12     0     0     0     0     0     0     0
     3RD +                           *                                     3RD   4      3     1     7     0     0     0     0     0     0     0
     4TH +                         *                                       4TH   1      1     7     7     0     0     0     0     0     0     6
     5TH +                             *                                   5TH   5      0     2     8     0     0     0     0     0     0     1
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
         0     10    20    30    40    50    60    70    80    90   100     PROP  0.14  0.06  0.15 (0.63) 0.00  0.00  0.00  0.00  0.00  0.00  0.01
                                                                          RPBI -0.27 -0.03 -0.16 (0.36) 0.00  0.00  0.00  0.00  0.00  0.00 -0.10
```

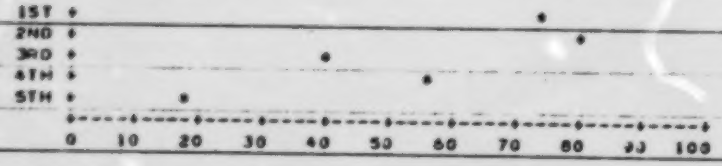
```
ITEM  91     PERCENT OF CORRECT RESPONSE BY FIFTHS            MATRIX OF RESPONSES BY FIFTHS                 D IS CORRECT RESPONSE

                                                                                 A      B     C    (D)    E     F     G     H     I     J  OMIT
     1ST +                                                    *            1ST   0      1     1    14     0     0     0     0     0     0     0
     2ND +                      *                                          2ND   1      4     5     6     0     0     0     0     0     0     0
     3RD +                                   *                             3RD   1      4     1     9     0     0     0     0     0     0     0
     4TH +                                 *                               4TH   1      0     6     9     0     0     0     0     0     0     0
     5TH +                                     *                           5TH   3      2     1    10     0     0     0     0     0     0     0
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
         0     10    20    30    40    50    60    70    80    90   100     PROP  0.08  0.14  0.18 (0.61) 0.00  0.00  0.00  0.00  0.00  0.00  0.00
                                                                          RPBI -0.18  0.04 -0.00 (0.07) 0.00  0.00  0.00  0.00  0.00  0.00  0.00
```

```
ITEM  92     PERCENT OF CORRECT RESPONSE BY FIFTHS            MATRIX OF RESPONSES BY FIFTHS                 C IS CORRECT RESPONSE

                                                                                 A      B    (C)    D     E     F     G     H     I     J  OMIT
     1ST +                                            *                    1ST   2      0    12     2     0     0     0     0     0     0     0
     2ND +                                     *                           2ND   4      2    10     0     0     0     0     0     0     0     0
     3RD +                               *                                 3RD   4      2     8     1     0     0     0     0     0     0     0
     4TH +                                     *                           4TH   5      1    10     0     0     0     0     0     0     0     0
     5TH +                                     *                           5TH   3      2    10     1     0     0     0     0     0     0     0
         +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
         0     10    20    30    40    50    60    70    80    90   100     PROP  0.23  0.09 (0.63) 0.05  0.00  0.00  0.00  0.00  0.00  0.00  0.00
                                                                          RPBI -0.02 -0.14 (0.04) 0.14  0.00  0.00  0.00  0.00  0.00  0.00  0.00
```

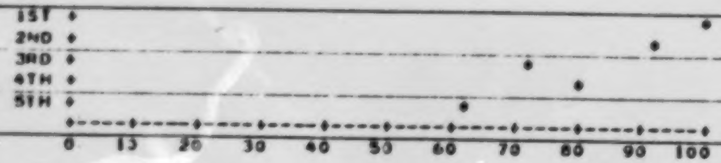
ITEM 93 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS B IS CORRECT RESPONSE

	A	(B)	C	D	E	F	G	H	I	J	OMIT
1ST	2	12	2	0	0	0	0	0	0	0	0
2ND	0	13	2	1	0	0	0	0	0	0	0
3RD	6	6	1	2	0	0	0	0	0	0	0
4TH	4	9	3	0	0	0	0	0	0	0	0
5TH	7	3	3	3	0	0	0	0	0	0	0
PROP	0.24	(0.54)	0.14	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.26	(0.38)	-0.11	-0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00

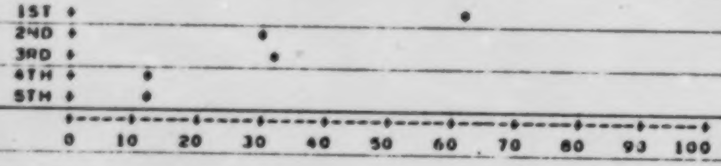
ITEM 94 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS D IS CORRECT RESPONSE

	A	B	C	(D)	E	F	G	H	I	J	OMIT
1ST	0	0	0	16	0	0	0	0	0	0	0
2ND	0	1	0	15	0	0	0	0	0	0	0
3RD	1	1	2	11	0	0	0	0	0	0	0
4TH	2	1	0	13	0	0	0	0	0	0	0
5TH	2	2	2	10	0	0	0	0	0	0	0
PROP	0.06	0.06	0.05	(0.82)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.17	-0.14	-0.18	(0.30)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

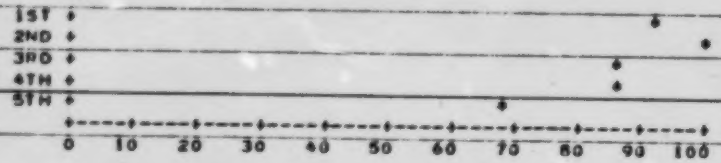
ITEM 95 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS A IS CORRECT RESPONSE

	(A)	B	C	D	E	F	G	H	I	J	OMIT
1ST	10	1	0	5	0	0	0	0	0	0	0
2ND	5	0	1	10	0	0	0	0	0	0	0
3RD	5	0	1	9	0	0	0	0	0	0	0
4TH	2	0	2	12	0	0	0	0	0	0	0
5TH	2	0	0	14	0	0	0	0	0	0	0
PROP	(0.33)	0.01	0.05	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	(0.40)	0.15	-0.05	-0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ITEM 96 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS B IS CORRECT RESPONSE

	A	(B)	C	D	E	F	G	H	I	J	OMIT
1ST	1	15	0	0	0	0	0	0	0	0	0
2ND	0	16	0	0	0	0	0	0	0	0	0
3RD	1	13	0	1	0	0	0	0	0	0	0
4TH	0	14	0	2	0	0	0	0	0	0	0
5TH	1	11	0	4	0	0	0	0	0	0	0
PROP	0.04	(0.87)	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.03	(0.30)	0.00	-0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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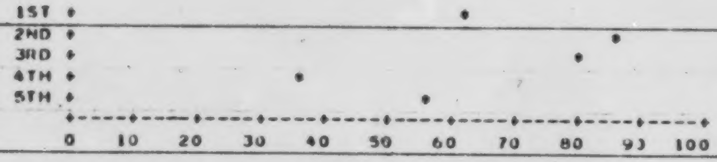
437

ITEM 97 PERCENT OF CORRECT RESPONSE BY FIFTHS

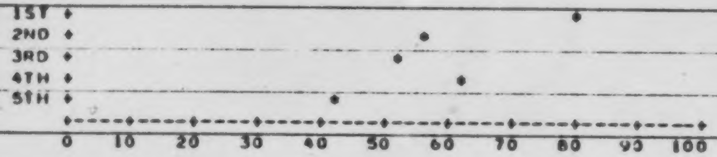


```
MATRIX OF RESPONSES BY FIFTHS                    A IS CORRECT RESPONSE

        (A)     B      C      D      E      F      G      H      I      J   OMIT
1ST      10     1      1      4      0      0      0      0      0      0      0
2ND      14     1      0      1      0      0      0      0      0      0      0
3RD      12     0      0      3      0      0      0      0      0      0      0
4TH       6     3      0      7      0      0      0      0      0      0      0
5TH       9     0      2      5      0      0      0      0      0      0      0

PROP (0.65)  0.06   0.04   0.25   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI (0.11)  0.03  -0.12  -0.08   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 98 PERCENT OF CORRECT RESPONSE BY FIFTHS

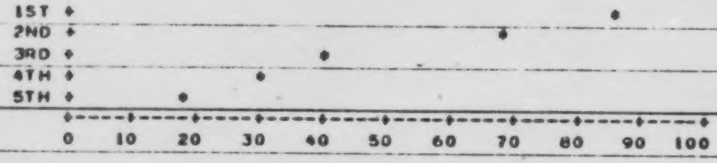


```
MATRIX OF RESPONSES BY FIFTHS                    C IS CORRECT RESPONSE

          A     B     (C)     D      E      F      G      H      I      J   OMIT
1ST       3     0     13      0      0      0      0      0      0      0      0
2ND       4     3      9      0      0      0      0      0      0      0      0
3RD       4     3      8      0      0      0      0      0      0      0      0
4TH       3     3     10      0      0      0      0      0      0      0      0
5TH       8     1      7      0      0      0      0      0      0      0      0

PROP   0.29  0.13 (0.59)  0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI  -0.22 -0.13 (0.29)  0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 99 PERCENT OF CORRECT RESPONSE BY FIFTHS

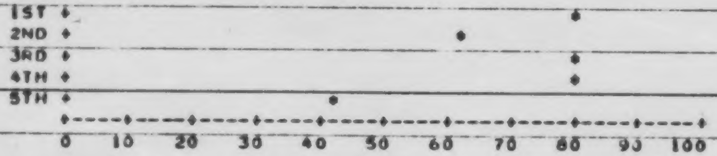


```
MATRIX OF RESPONSES BY FIFTHS                    B IS CORRECT RESPONSE

          A    (B)     C      D      E      F      G      H      I      J   OMIT
1ST       0    14      2      0      0      0      0      0      0      0      0
2ND       2    11      2      1      0      0      0      0      0      0      0
3RD       7     6      2      0      0      0      0      0      0      0      0
4TH      11     5      0      0      0      0      0      0      0      0      0
5TH      10     3      2      1      0      0      0      0      0      0      0

PROP   0.38 (0.49)  0.10   0.03   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI  -0.46 (0.48)  0.03  -0.16   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 100 PERCENT OF CORRECT RESPONSE BY FIFTHS

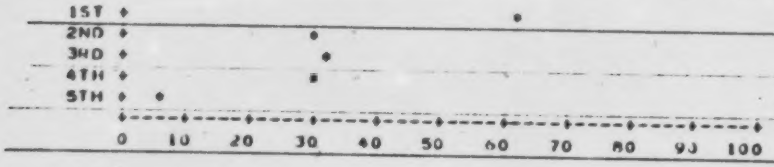


```
MATRIX OF RESPONSES BY FIFTHS                    A IS CORRECT RESPONSE

        (A)     B      C      D      E      F      G      H      I      J   OMIT
1ST      13     0      1      2      0      0      0      0      0      0      0
2ND      10     1      0      5      0      0      0      0      0      0      0
3RD      12     0      1      2      0      0      0      0      0      0      0
4TH      13     0      0      2      0      0      0      0      0      0      1
5TH       7     1      2      6      0      0      0      0      0      0      0

PROP (0.70)  0.03   0.05   0.22   0.00   0.00   0.00   0.00   0.00   0.00   0.01
RPBI (0.19) -0.01  -0.05  -0.16   0.00   0.00   0.00   0.00   0.00   0.00  -0.07
```

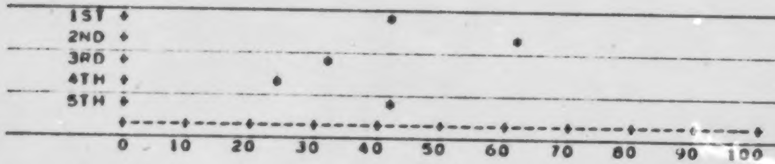
ITEM 101 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS D IS CORRECT RESPONSE

	A	B	C	(D)	E	F	G	H	I	J	OMIT
1ST	3	2	1	10	0	0	0	0	0	0	0
2ND	6	3	2	5	0	0	0	0	0	0	0
3RD	7	1	2	5	0	0	0	0	0	0	0
4TH	4	4	3	5	0	0	0	0	0	0	0
5TH	5	7	3	1	0	0	0	0	0	0	0
PROP	0.32	0.22	0.14	(0.33)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.05	-0.27	-0.10	(0.36)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

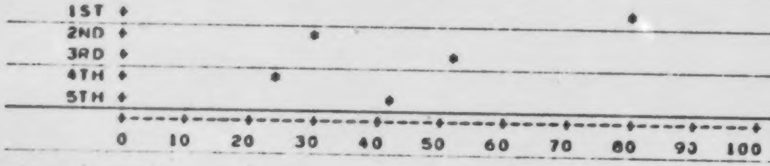
ITEM 102 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS A IS CORRECT RESPONSE

	(A)	B	C	D	E	F	G	H	I	J	OMIT
1ST	7	1	1	7	0	0	0	0	0	0	0
2ND	10	1	1	4	0	0	0	0	0	0	0
3RD	5	2	0	8	0	0	0	0	0	0	0
4TH	4	0	1	11	0	0	0	0	0	0	0
5TH	7	1	2	6	0	0	0	0	0	0	0
PROP	(0.42)	0.06	0.06	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	(0.09)	0.03	-0.15	-0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00

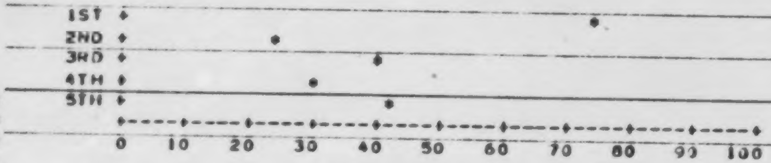
ITEM 103 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS B IS CORRECT RESPONSE

	A	(B)	C	D	E	F	G	H	I	J	OMIT
1ST	2	13	0	1	0	0	0	0	0	0	0
2ND	9	5	1	0	0	0	0	0	0	0	1
3RD	5	8	0	2	0	0	0	0	0	0	0
4TH	8	4	1	2	0	0	0	0	0	0	1
5TH	4	7	2	3	0	0	0	0	0	0	0
PROP	0.35	(0.47)	0.05	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.03
RPBI	-0.07	(0.24)	-0.15	-0.15	0.00	0.00	0.00	0.00	0.00	0.00	-0.04

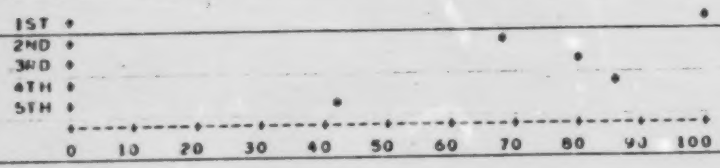
ITEM 104 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS B IS CORRECT RESPONSE

	A	(B)	C	D	E	F	G	H	I	J	OMIT
1ST	1	12	3	0	0	0	0	0	0	0	0
2ND	1	4	6	5	0	0	0	0	0	0	0
3RD	0	6	9	0	0	0	0	0	0	0	0
4TH	0	5	9	2	0	0	0	0	0	0	0
5TH	0	7	8	1	0	0	0	0	0	0	0
PROP	0.03	(0.43)	0.44	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	0.19	(0.24)	-0.29	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00

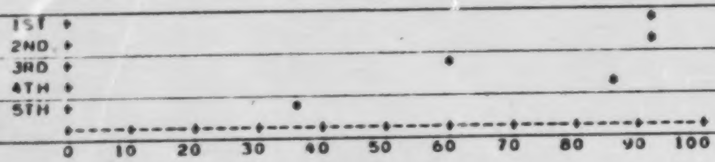
ITEM 105 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS C IS CORRECT RESPONSE

	A	B	(C)	D	E	F	G	H	I	J	OMIT
1ST	0	0	16	0	0	0	0	0	0	0	0
2ND	3	0	11	2	0	0	0	0	0	0	0
3RD	0	2	12	1	0	0	0	0	0	0	0
4TH	0	1	14	1	0	0	0	0	0	0	0
5TH	1	4	7	3	0	0	0	0	0	0	1
PROP	0.05	0.09	(0.76)	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.01
RPBI	-0.00	-0.27	(0.33)	-0.14	0.00	0.00	0.00	0.00	0.00	0.00	-0.24

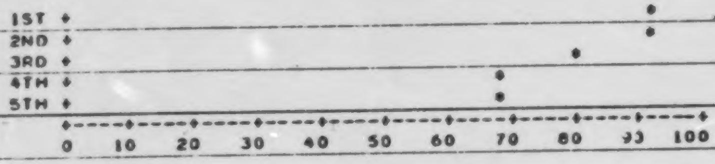
ITEM 106 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS A IS CORRECT RESPONSE

	(A)	B	C	D	E	F	G	H	I	J	OMIT
1ST	15	1	0	0	0	0	0	0	0	0	0
2ND	15	1	0	0	0	0	0	0	0	0	0
3RD	9	4	1	1	0	0	0	0	0	0	0
4TH	14	2	0	0	0	0	0	0	0	0	0
5TH	6	5	0	5	0	0	0	0	0	0	0
PROP	(0.75)	0.16	0.01	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	(0.37)	-0.20	-0.00	-0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00

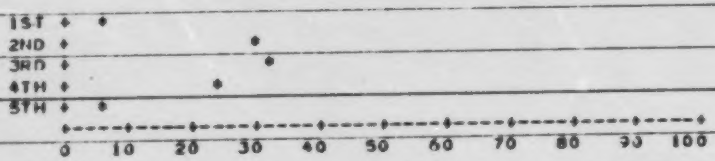
ITEM 107 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS D IS CORRECT RESPONSE

	A	B	C	(D)	E	F	G	H	I	J	OMIT
1ST	0	0	1	15	0	0	0	0	0	0	0
2ND	0	0	1	15	0	0	0	0	0	0	0
3RD	0	1	2	12	0	0	0	0	0	0	0
4TH	1	1	3	11	0	0	0	0	0	0	0
5TH	2	1	2	11	0	0	0	0	0	0	0
PROP	0.04	0.04	0.11	(0.81)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.24	-0.14	-0.11	(0.28)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

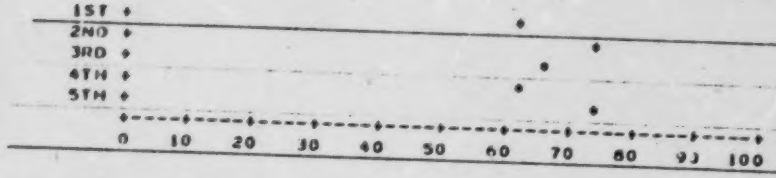
ITEM 108 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS A IS CORRECT RESPONSE

	(A)	B	C	D	E	F	G	H	I	J	OMIT
1ST	1	5	0	10	0	0	0	0	0	0	0
2ND	5	2	5	4	0	0	0	0	0	0	0
3RD	5	4	3	3	0	0	0	0	0	0	0
4TH	4	6	2	4	0	0	0	0	0	0	0
5TH	1	2	1	12	0	0	0	0	0	0	0
PROP	(0.20)	0.24	0.14	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	(0.02)	0.05	-0.02	-0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ITEM 109 PERCENT OF CORRECT RESPONSE BY FIFTHS

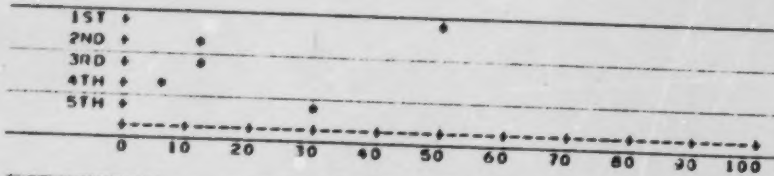


MATRIX OF RESPONSES BY FIFTHS

C IS CORRECT RESPONSE

	A	B	(C)	D	E	F	G	H	I	J	OMIT
1ST	0	0	10	6	0	0	0	0	0	0	0
2ND	1	1	12	2	0	0	0	0	0	0	0
3RD	0	0	10	5	0	0	0	0	0	0	0
4TH	1	0	10	5	0	0	0	0	0	0	0
5TH	0	1	12	3	0	0	0	0	0	0	0
PROP	0.03	0.03	(0.68)	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.03	-0.12	(0.01)	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ITEM 110 PERCENT OF CORRECT RESPONSE BY FIFTHS

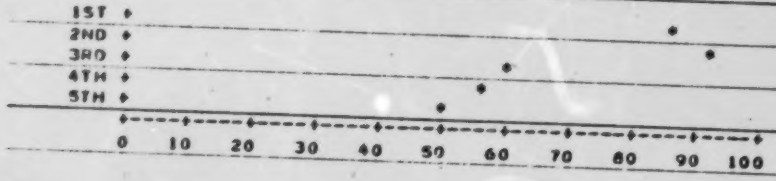


MATRIX OF RESPONSES BY FIFTHS

D IS CORRECT RESPONSE

	A	B	C	(D)	E	F	G	H	I	J	OMIT
1ST	1	5	2	8	0	0	0	0	0	0	0
2ND	4	6	4	2	0	0	0	0	0	0	0
3RD	0	9	4	2	0	0	0	0	0	0	0
4TH	3	6	4	1	0	0	0	0	0	0	2
5TH	2	5	3	5	0	0	0	0	0	0	1
PROP	0.13	0.39	0.22	(0.23)	0.00	0.00	0.00	0.00	0.00	0.00	0.04
RPBI	-0.05	-0.04	-0.04	(0.18)	0.00	0.00	0.00	0.00	0.00	0.00	-0.12

ITEM 111 PERCENT OF CORRECT RESPONSE BY FIFTHS

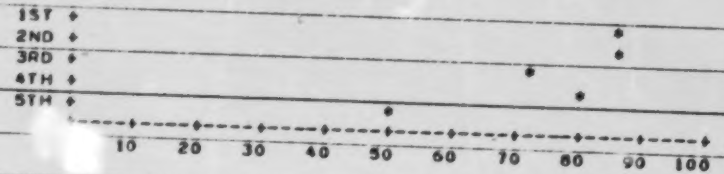


MATRIX OF RESPONSES BY FIFTHS

B IS CORRECT RESPONSE

	A	(B)	C	D	E	F	G	H	I	J	OMIT
1ST	0	14	1	1	0	0	0	0	0	0	0
2ND	1	15	0	0	0	0	0	0	0	0	0
3RD	1	9	5	0	0	0	0	0	0	0	0
4TH	0	9	5	1	0	0	0	0	0	0	1
5TH	1	8	6	1	0	0	0	0	0	0	0
PROP	0.04	(0.70)	0.22	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.01
RPBI	-0.03	(0.37)	-0.35	-0.05	0.00	0.00	0.00	0.00	0.00	0.00	-0.07

ITEM 112 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS

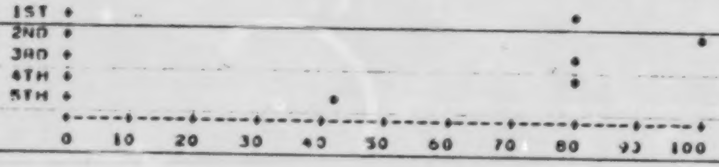
A IS CORRECT RESPONSE

	(A)	B	C	D	E	F	G	H	I	J	OMIT
1ST	14	0	0	2	0	0	0	0	0	0	0
2ND	14	0	1	1	0	0	0	0	0	0	0
3RD	11	1	0	3	0	0	0	0	0	0	0
4TH	13	0	0	3	0	0	0	0	0	0	0
5TH	8	1	1	6	0	0	0	0	0	0	0
PROP	(0.76)	0.03	0.03	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	(0.32)	-0.15	-0.04	-0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00

414

415

ITEM 113   PERCENT OF CORRECT RESPONSE BY FIFTHS

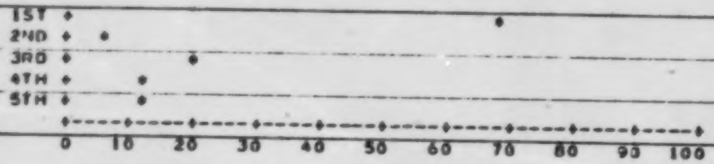


```
MATRIX OF RESPONSES BY FIFTHS                          C IS CORRECT RESPONSE

             A      B     (C)     D      E      F      G      H      I      J   OMIT
1ST          1      2     13      0      0      0      0      0      0      0      0
2ND          0      0     16      0      0      0      0      0      0      0      0
3R3          0      2     12      1      0      0      0      0      0      0      0
4TH          2      0     13      1      0      0      0      0      0      0      0
5TH          3      4      7      1      0      0      0      0      0      0      1

PROP      0.08   0.10 (0.77) 0.04   0.00   0.00   0.00   0.00   0.00   0.00   0.01
RPBI     -0.27  -0.07 (0.35)-0.15   0.00   0.00   0.00   0.00   0.00   0.00  -0.24
```

ITEM 114   PERCENT OF CORRECT RESPONSE BY FIFTHS

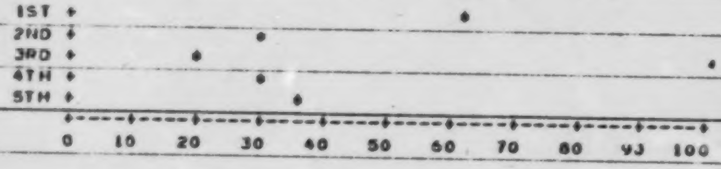


```
MATRIX OF RESPONSES BY FIFTHS                          C IS CORRECT RESPONSE

             A      B     (C)     D      E      F      G      H      I      J   OMIT
1ST          0      4     11      1      0      0      0      0      0      0      0
2ND          0     10      1      5      0      0      0      0      0      0      0
3RD          0      7      3      5      0      0      0      0      0      0      0
4TH          0     10      2      3      0      0      0      0      0      0      1
5TH          1     11      2      2      0      0      0      0      0      0      0

PROP      0.01   0.53 (0.24) 0.20   0.00   0.00   0.00   0.00   0.00   0.00   0.01
RPBI     -0.24  -0.23 (0.41)-0.07   0.00   0.00   0.00   0.00   0.00   0.00  -0.07
```

ITEM 115   PERCENT OF CORRECT RESPONSE BY FIFTHS

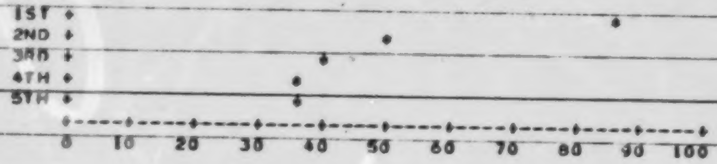


```
MATRIX OF RESPONSES BY FIFTHS                          C IS CORRECT RESPONSE

             A      B     (C)     D      E      F      G      H      I      J   OMIT
1ST          5      1     10      0      0      0      0      0      0      0      0
2ND          8      3      5      0      0      0      0      0      0      0      0
3RD          7      2      3      3      0      0      0      0      0      0      0
4TH          3      3      5      3      0      0      0      0      0      0      2
5TH          5      2      6      3      0      0      0      0      0      0      0

PROP      0.35   0.14 (0.37) 0.11   0.00   0.00   0.00   0.00   0.00   0.00   0.03
RPBI      0.03  -0.07 (0.19)-0.21   0.00   0.00   0.00   0.00   0.00   0.00  -0.11
```

ITEM 116   PERCENT OF CORRECT RESPONSE BY FIFTHS

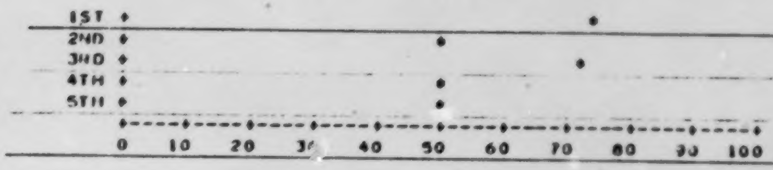


```
MATRIX OF RESPONSES BY FIFTHS                          C IS CORRECT RESPONSE

             A      B     (C)     D      E      F      G      H      I      J   OMIT
1ST          1      0     14      1      0      0      0      0      0      0      0
2ND          2      3      8      3      0      0      0      0      0      0      0
3RD          3      4      6      2      0      0      0      0      0      0      0
4TH          2      6      6      1      0      0      0      0      0      0      1
5TH          2      7      6      1      0      0      0      0      0      0      0

PROP      0.13   0.25 (0.51) 0.10   0.00   0.00   0.00   0.00   0.00   0.00   0.01
RPBI     -0.04  -0.33 (0.37)-0.05   0.00   0.00   0.00   0.00   0.00   0.00  -0.07
```

ITEM 117 PERCENT OF CORRECT RESPONSE BY FIFTHS

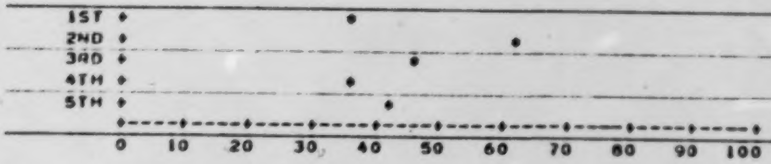


MATRIX OF RESPONSES BY FIFTHS A IS CORRECT RESPONSE

```
          (A)      B      C      D      E      F      G      H      I      J   OMIT
 1ST      12       4      0      0      0      0      0      0      0      0      0
 2ND       8       8      0      0      0      0      0      0      0      0      0
 3RD      11       3      1      0      0      0      0      0      0      0      0
 4TH       8       7      0      1      0      0      0      0      0      0      0
 5TH       8       5      0      3      0      0      0      0      0      0      0

PROP   (0.59)  0.34   0.01   0.05   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI   (0.20)-0.06  -0.03  -0.31   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 118 PERCENT OF CORRECT RESPONSE BY FIFTHS

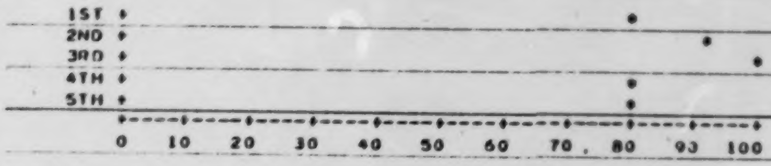


MATRIX OF RESPONSES BY FIFTHS A IS CORRECT RESPONSE

```
          (A)      B      C      D      E      F      G      H      I      J   OMIT
 1ST       6       4      3      3      0      0      0      0      0      0      0
 2ND      10       2      2      2      0      0      0      0      0      0      0
 3RD       7       2      3      3      0      0      0      0      0      0      0
 4TH       6       3      4      3      0      0      0      0      0      0      0
 5TH       7       4      2      3      0      0      0      0      0      0      0

PROP   (0.46)  0.19   0.18   0.18   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI   (0.01)-0.02   0.02   0.01   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 119 PERCENT OF CORRECT RESPONSE BY FIFTHS

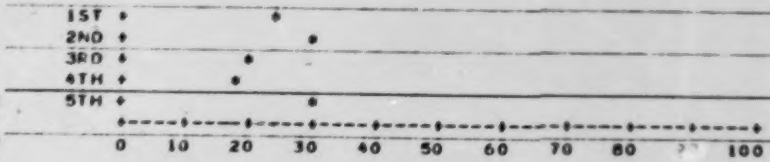


MATRIX OF RESPONSES BY FIFTHS D IS CORRECT RESPONSE

```
           A      B      C     (D)     E      F      G      H      I      J   OMIT
 1ST       2      0      1     13      0      0      0      0      0      0      0
 2ND       0      1      0     15      0      0      0      0      0      0      0
 3RD       0      0      0     15      0      0      0      0      0      0      0
 4TH       1      0      2     13      0      0      0      0      0      0      0
 5TH       1      0      2     13      0      0      0      0      0      0      0

PROP    0.05   0.01   0.06  (0.87)  0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI    0.05   0.06  -0.12  (0.03)  0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 120 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS D IS CORRECT RESPONSE

```
           A      B      C     (D)     E      F      G      H      I      J   OMIT
 1ST       3      1      8      4      0      0      0      0      0      0      0
 2ND       3      6      2      5      0      0      0      0      0      0      0
 3RD       2      5      5      3      0      0      0      0      0      0      0
 4TH       3      4      6      3      0      0      0      0      0      0      0
 5TH       2      2      7      5      0      0      0      0      0      0      0

PROP    0.16   0.23   0.35  (0.25)  0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI    0.05  -0.00  -0.04  (0.00)  0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

PRINTED IN U.S.A.

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MT Hematology
1981

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MT HEMATOLOGY EXAM

                    SUMMARY OF TEST STATISTICS

            NUMBER OF ITEMS                          120

            MEAN SCORE                             74.41

            MEDIAN SCORE                           74.50

            STANDARD DEVIATION                     13.32

            RELIABILITY (KR-20)                    0.867

            RELIABILITY (KR-21)                    0.848

            S.E. OF MEASUREMENT                     4.86

            POSSIBLE LOW SCORE                         0
            POSSIBLE HIGH SCORE                      120

            OBTAINED LOW SCORE                        45
            OBTAINED HIGH SCORE                       98

            NUMBER OF SCORES                         124
                 BLANK SCORES                          0
                 INVALID SCORES                        0
                 VALID SCORES                        124
```

450

451

II

FORM 1411-3

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                              MT HEMATOLOGY EXAM

                                            TEST FREQUENCY DISTRIBUTION

  RAW    STANDARD    PER                              CUM
 SCORE    SCORE    CENTILE    PERCENT     FREQ       FREQ
                                                              EACH * REPRESENTS  1 PERSON(S)
   98      677        99        0.8         1        124      *
   97      670        99        0.8         1        123      *
   96      662        97        2.4         3        122      ***
   95      655        96        0.8         1        119      *
   94      647        95        0.8         1        118      *
   93      640        94        1.6         2        117      **
   92      632        91        4.0         5        115      *****
   91      625        88        1.6         2        110      **
   90      617        86        1.6         2        108      **
   89      610        83        4.0         5        106      *****
   88      602        81        1.6         2        101      **
   87      595        79        1.6         2         99      **
   86      587        77        3.2         4         97      ****
   85      580        74        1.6         2         93      **
   84      572        73        0.8         1         91      *
   83      564        71        3.2         4         90      ****
   82      557        67        4.0         5         86      *****
   81      549        64        2.4         3         81      ***
   80      542        61        4.0         5         78      *****
   79      534        58        1.6         2         73      **
   78      527        57        0.8         1         71      *
   77      519        55        3.2         4         70      ****
   76      512        52        1.6         2         66      **
   75      504        51        1.6         2         64      **
   74      497        48        3.2         4         62      ****
   73      489        45        3.2         4         58      ****
   72      482        43        1.6         2         54      **
   71      474        41        2.4         3         52      ***
   70      467        39        1.6         2         49      **
   69      459        37        2.4         3         47      ***
   68      452        33        4.0         5         44      *****
   67      444        30        3.2         4         39      ****
   66      437        27        2.4         3         35      ***
   65      429        25        1.6         2         32      **
   64      422        23        3.2         4         30      ****
   63      414        21        0.8         1         26      *
   62      407        19        1.6         2         25      **
   61      399        17        2.4         3         23      ***
   60      392        15        2.4         3         20      ***
   59      384        13        0.8         1         17      *
   58      377        12        1.6         2         16      **
   57      369        11        0.8         1         14      *
   56      362        10        1.6         2         13      **
   55      354         9        0.0         0         11
   54      347         8        0.8         1         11      *
```

```
     53       339       7       1.6       2    10        **
     52       332       6       1.6       2     8        **
     51       324       5       0.0       0     6
     50       317       5       0.0       0     6
     49       309       4       0.8       1     6        *
     48       302       3       1.6       2     5        **
     47       294       2       0.0       0     3
     46       287       2       0.8       1     3        *
     45       279       1       1.6       2     2        **
```

```
                    THE QUINTILE GRAPH AND MATRIX OF RESPONSES
                    APPEARING WITH EACH ITEM ARE BASED ON THE
                    STATISTICS INDICATED IN THE TABLE BELOW :

                QUINTILE    SAMPLE SIZE    PROPORTION    SCORE RANGE

                   1ST          25            0.20         88 -  98
                   2ND          26            0.21         80 -  87
                   3RD          24            0.19         71 -  79
                   4TH          24            0.19         63 -  70
                   5TH          25            0.20         45 -  62
```

FORM 1411-3

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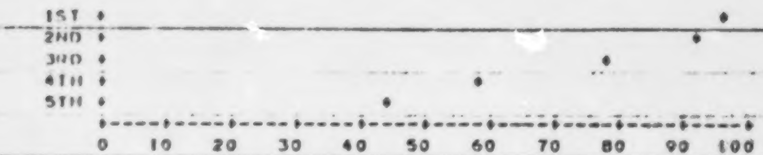
ITEM 1 PERCENT OF CORRECT RESPONSE BY FIFTHS

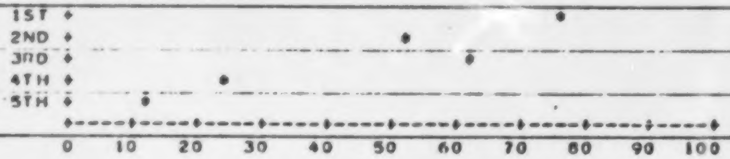


```
MATRIX OF RESPONSES BY FIFTHS                    B IS CORRECT RESPONSE

              A     (B)     C      D      E      F      G      H      I      J   OMIT
    1ST       0      24     0      1      0      0      0      0      0      0      0
    2ND       1      24     0      1      0      0      0      0      0      0      0
    3RD       0      19     0      5      0      0      0      0      0      0      0
    4TH       2      14     0      8      0      0      0      0      0      0      0
    5TH       5      11     2      7      0      0      0      0      0      0      0

   PROP    0.06  (0.74)  0.02   0.18   0.00   0.00   0.00   0.00   0.00   0.00   0.00
   RPBI   -0.27  (0.44)-0.28  -0.24   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 2 PERCENT OF CORRECT RESPONSE BY FIFTHS

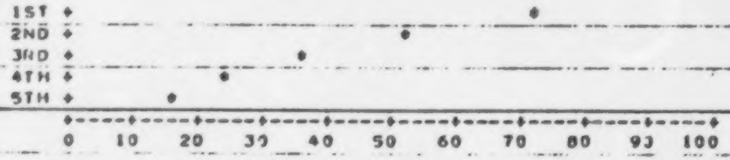


```
MATRIX OF RESPONSES BY FIFTHS                    D IS CORRECT RESPONSE

              A      B      C     (D)     E      F      G      H      I      J   OMIT
    1ST       0      2      4     19      0      0      0      0      0      0      0
    2ND       0      3      9     14      0      0      0      0      0      0      0
    3RD       2      4      3     15      0      0      0      0      0      0      0
    4TH       5      7      6      6      0      0      0      0      0      0      0
    5TH       3     13      6      3      0      0      0      0      0      0      0

   PROP    0.08   0.23   0.23  (0.46)  0.00   0.00   0.00   0.00   0.00   0.00   0.00
   RPBI   -0.19  -0.38  -0.04  (0.46)  0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 3 PERCENT OF CORRECT RESPONSE BY FIFTHS

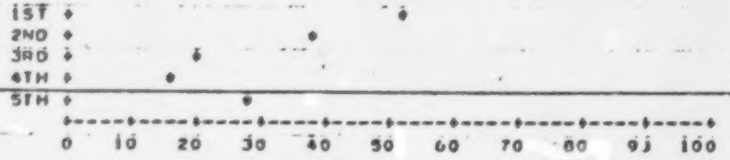


```
MATRIX OF RESPONSES BY FIFTHS                    A IS CORRECT RESPONSE

             (A)     B      C      D      E      F      G      H      I      J   OMIT
    1ST      18      1      4      2      0      0      0      0      0      0      0
    2ND      14      2      2      7      0      0      0      0      0      0      1
    3RD       9      8      2      5      0      0      0      0      0      0      0
    4TH       6      3      3     12      0      0      0      0      0      0      0
    5TH       4      8      4      7      0      0      0      0      0      0      2

   PROP   (0.41)  0.18   0.12   0.27   0.00   0.00   0.00   0.00   0.00   0.00   0.02
   RPBI   (0.40)-0.23  -0.01  -0.18   0.00   0.00   0.00   0.00   0.00   0.00  -0.18
```

ITEM 4 PERCENT OF CORRECT RESPONSE BY FIFTHS

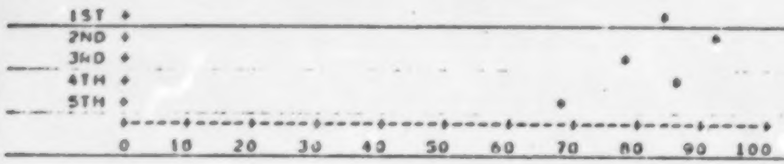


```
MATRIX OF RESPONSES BY FIFTHS                    D IS CORRECT RESPONSE

              A      B      C     (D)     E      F      G      H      I      J   OMIT
    1ST       3      0      7     13      0      0      0      0      0      0      2
    2ND       3      6      7     10      0      0      0      0      0      0      0
    3RD       3      3     12      5      0      0      0      0      0      0      1
    4TH       3      6     11      4      0      0      0      0      0      0      0
    5TH       5      5      5      7      0      0      0      0      0      0      2

   PROP    0.15   0.16   0.34  (0.31)  0.00   0.00   0.00   0.00   0.00   0.00   0.04
   RPBI   -0.11  -0.15  -0.00  (0.23)  0.00   0.00   0.00   0.00   0.00   0.00  -0.05
```

ITEM 5 PERCENT OF CORRECT RESPONSE BY FIFTHS

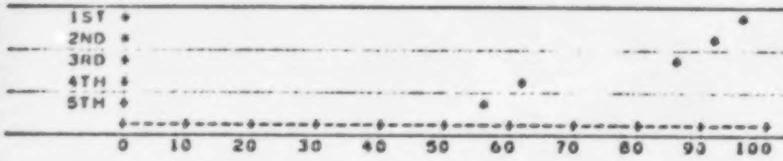


```
MATRIX OF RESPONSES BY FIFTHS                          B IS CORRECT RESPONSE

          A     (B)     C      D      E      F      G      H      I      J   OMIT
  1ST     1     21      3      0      0      0      0      0      0      0      0
  2ND     0     24      2      0      0      0      0      0      0      0      0
  3RD     0     19      5      0      0      0      0      0      0      0      0
  4TH     2     21      1      0      0      0      0      0      0      0      0
  5TH     6     17      2      0      0      0      0      0      0      0      0

PROP   0.07 (0.82) 0.10   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI  -0.24 (0.10) 0.07   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 6 PERCENT OF CORRECT RESPONSE BY FIFTHS

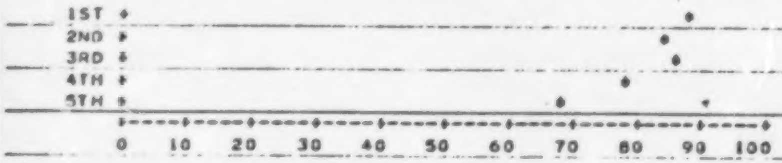


```
MATRIX OF RESPONSES BY FIFTHS                          C IS CORRECT RESPONSE

          A      B     (C)     D      E      F      G      H      I      J   OMIT
  1ST     0      1     24      0      0      0      0      0      0      0      0
  2ND     0      2     24      0      0      0      0      0      0      0      0
  3RD     0      3     21      0      0      0      0      0      0      0      0
  4TH     2      6     15      1      0      0      0      0      0      0      0
  5TH     2      8     14      1      0      0      0      0      0      0      0

PROP   0.03   0.16 (0.79) 0.02   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI  -0.27  -0.33 (0.44)-0.10   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 7 PERCENT OF CORRECT RESPONSE BY FIFTHS

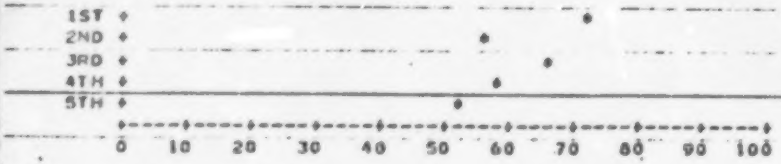


```
MATRIX OF RESPONSES BY FIFTHS                          C IS CORRECT RESPONSE

          A      B     (C)     D      E      F      G      H      I      J   OMIT
  1ST     2      0     22      1      0      0      0      0      0      0      0
  2ND     1      3     22      0      0      0      0      0      0      0      0
  3RD     2      1     21      0      0      0      0      0      0      0      0
  4TH     3      2     19      0      0      0      0      0      0      0      0
  5TH     3      2     17      3      0      0      0      0      0      0      0

PROP   0.09   0.06 (0.81) 0.03   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI  -0.09  -0.11 (0.23)-0.21   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 8 PERCENT OF CORRECT RESPONSE BY FIFTHS



```
MATRIX OF RESPONSES BY FIFTHS                          D IS CORRECT RESPONSE

          A      B      C     (D)     E      F      G      H      I      J   OMIT
  1ST     2      3      2     18      0      0      0      0      0      0      0
  2ND     4      4      3     15      0      0      0      0      0      0      0
  3RD     3      5      0     16      0      0      0      0      0      0      0
  4TH     3      7      0     14      0      0      0      0      0      0      0
  5TH     4      7      1     13      0      0      0      0      0      0      0

PROP   0.13   0.21   0.05 (0.61) 0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI  -0.03  -0.14   0.16 (0.11) 0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

```
MAY 21, 1981                    * * *   MERMAC -- TEST ANALYSIS AND QUESTIONNAIRE PACKAGE   * * *                    150

ITEM   9     PERCENT OF CORRECT RESPONSE BY FIFTHS          MATRIX OF RESPONSES BY FIFTHS              C IS CORRECT RESPONSE

                                                                   A      B    (C)      D      E      F      G      H      I      J   OMIT
  1ST +                             *                        1ST       3      4     15      3      0      0      0      0      0      0      0
  2ND +                    *                                 2ND       7      3     11      4      0      0      0      0      0      0      1
  3RD +                 *                                    3RD      10      1      9      3      0      0      0      0      0      0      1
  4TH +             *                                        4TH       9      4      7      4      0      0      0      0      0      0      0
  5TH +                     *                                5TH       5      4     11      5      0      0      0      0      0      0      0
      +----+----+----+----+----+----+----+----+----+----+
      0    10   20   30   40   50   60   70   80   90   100    PROP   0.27   0.13 (0.43)  0.15   0.00   0.00   0.00   0.00   0.00   0.00   0.02
                                                             RPBI  -0.07  -0.03 (0.14)-0.09   0.00   0.00   0.00   0.00   0.00   0.00   0.04

ITEM  10     PERCENT OF CORRECT RESPONSE BY FIFTHS          MATRIX OF RESPONSES BY FIFTHS              B IS CORRECT RESPONSE

                                                                   A    (B)      C      D      E      F      G      H      I      J   OMIT
  1ST +                       *                              1ST       8     12      2      2      0      0      0      0      0      0      1
  2ND +                        *                             2ND      10     13      2      1      0      0      0      0      0      0      0
  3RD +                        *                             3RD       6     12      4      2      0      0      0      0      0      0      0
  4TH +                        *                             4TH       6     12      4      2      0      0      0      0      0      0      0
  5TH +                     *                                5TH       9     11      4      1      0      0      0      0      0      0      0
      +----+----+----+----+----+----+----+----+----+----+
      0    10   20   30   40   50   60   70   80   90   100    PROP   0.31 (0.48)  0.13   0.06   0.00   0.00   0.00   0.00   0.00   0.00   0.01
                                                             RPBI   0.02 (0.03)-0.11   0.02   0.00   0.00   0.00   0.00   0.00   0.00   0.10

ITEM  11     PERCENT OF CORRECT RESPONSE BY FIFTHS          MATRIX OF RESPONSES BY FIFTHS              D IS CORRECT RESPONSE

                                                                   A      B      C    (D)      E      F      G      H      I      J   OMIT
  1ST +                               *                      1ST       0      1      8     16      0      0      0      0      0      0      0
  2ND +                          *                           2ND       1      3      8     14      0      0      0      0      0      0      0
  3RD +                 *                                    3RD       3      2     10      9      0      0      0      0      0      0      0
  4TH +                   *                                  4TH       2      3      8     10      0      0      0      0      0      0      1
  5TH +                   *                                  5TH       2      4      8     10      0      0      0      0      0      0      1
      +----+----+----+----+----+----+----+----+----+----+
      0    10   20   30   40   50   60   70   80   90   100    PROP   0.06   0.10   0.34 (0.48)  0.00   0.00   0.00   0.00   0.00   0.00   0.02
                                                             RPBI  -0.13  -0.09  -0.02 (0.18)  0.00   0.00   0.00   0.00   0.00   0.00  -0.13

ITEM  12     PERCENT OF CORRECT RESPONSE BY FIFTHS          MATRIX OF RESPONSES BY FIFTHS              C IS CORRECT RESPONSE

                                                                   A      B    (C)      D      E      F      G      H      I      J   OMIT
  1ST +                                               *      1ST       0      0     24      1      0      0      0      0      0      0      0
  2ND +                                             *        2ND       0      0     24      2      0      0      0      0      0      0      0
  3RD +                                            *         3RD       0      0     22      2      0      0      0      0      0      0      0
  4TH +                                            *         4TH       1      0     22      1      0      0      0      0      0      0      0
  5TH +                               *                      5TH       0      1     16      8      0      0      0      0      0      0      0
      +----+----+----+----+----+----+----+----+----+----+
      0    10   20   30   40   50   60   70   80   90   100    PROP   0.01   0.01 (0.87)  0.11   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                             RPBI  -0.04  -0.09 (0.28)-0.26   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

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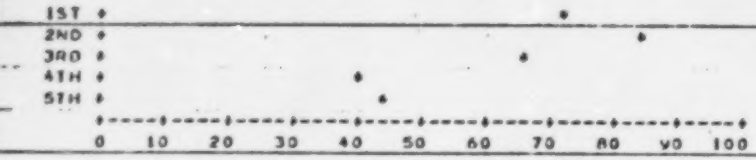
462

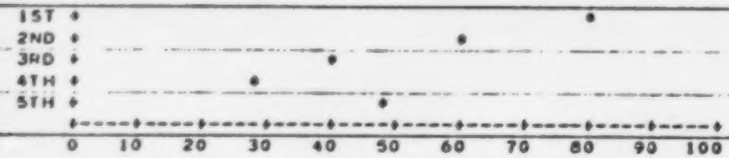
ITEM 13 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS D IS CORRECT RESPONSE

	A	B	C	(D)	E	F	G	H	I	J	OMIT
1ST	2	1	4	18	0	0	0	0	0	0	0
2ND	0	0	4	22	0	0	0	0	0	0	0
3RD	0	2	6	16	0	0	0	0	0	0	0
4TH	2	7	5	10	0	0	0	0	0	0	0
5TH	7	3	3	11	0	0	0	0	0	0	1
PROP	0.09	0.10	0.18	(0.62)	0.00	0.00	0.00	0.00	0.00	0.00	0.01
RPBI	-0.30	-0.19	0.02	(0.31)	0.00	0.00	0.00	0.00	0.00	0.00	-0.15

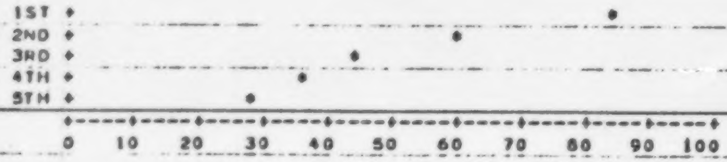
ITEM 14 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS C IS CORRECT RESPONSE

	A	B	(C)	D	E	F	G	H	I	J	OMIT
1ST	1	1	20	3	0	0	0	0	0	0	0
2ND	4	4	16	2	0	0	0	0	0	0	0
3RD	3	3	10	8	0	0	0	0	0	0	0
4TH	3	2	7	12	0	0	0	0	0	0	0
5TH	2	7	12	4	0	0	0	0	0	0	0
PROP	0.10	0.14	(0.52)	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.00	-0.16	(0.25)	-0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00

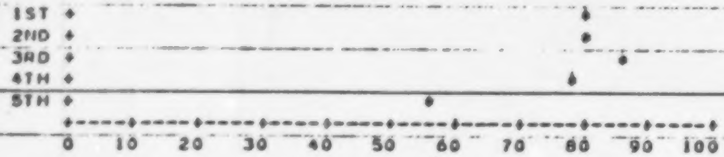
ITEM 15 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS B IS CORRECT RESPONSE

	A	(B)	C	D	E	F	G	H	I	J	OMIT
1ST	2	21	2	0	0	0	0	0	0	0	0
2ND	2	16	8	0	0	0	0	0	0	0	0
3RD	6	11	7	0	0	0	0	0	0	0	0
4TH	8	9	5	2	0	0	0	0	0	0	0
5TH	9	7	8	1	0	0	0	0	0	0	0
PROP	0.22	(0.52)	0.24	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.28	(0.35)	-0.10	-0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00

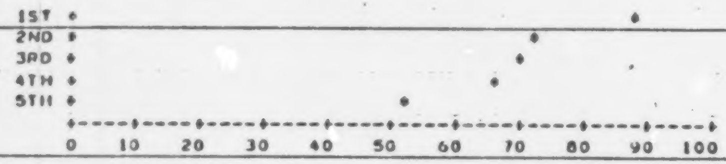
ITEM 16 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS B IS CORRECT RESPONSE

	A	(B)	C	D	E	F	G	H	I	J	OMIT
1ST	0	20	3	2	0	0	0	0	0	0	0
2ND	0	21	1	4	0	0	0	0	0	0	0
3RD	1	21	1	1	0	0	0	0	0	0	0
4TH	1	19	4	0	0	0	0	0	0	0	0
5TH	5	14	2	3	0	0	0	0	0	0	1
PROP	0.06	(0.77)	0.09	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.01
RPBI	-0.33	(0.21)	-0.03	0.05	0.00	0.00	0.00	0.00	0.00	0.00	-0.20

ITEM 17   PERCENT OF CORRECT RESPONSE BY FIFTHS

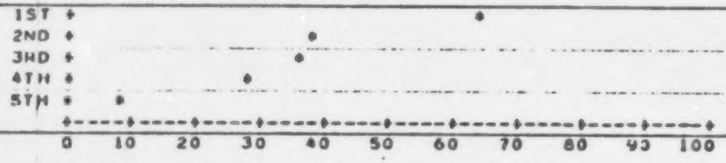


```
MATRIX OF RESPONSES BY FIFTHS                       B IS CORRECT RESPONSE

            A     (B)     C      D      E      F      G      H      I      J   OMIT
 1ST        2     22      1      0      0      0      0      0      0      0      0
 2ND        4     19      0      3      0      0      0      0      0      0      0
 3RD        0     17      4      3      0      0      0      0      0      0      0
 4TH        3     16      1      4      0      0      0      0      0      0      0
 5TH        6     13      2      4      0      0      0      0      0      0      0

PROP     0.12 (0.70) 0.06   0.11   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI    -0.15 (0.28)-0.06  -0.21   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 18   PERCENT OF CORRECT RESPONSE BY FIFTHS

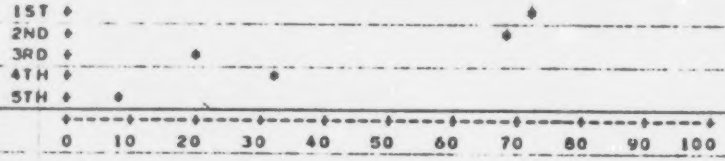


```
MATRIX OF RESPONSES BY FIFTHS                       A IS CORRECT RESPONSE

           (A)     B      C      D      E      F      G      H      I      J   OMIT
 1ST       16      3      2      4      0      0      0      0      0      0      0
 2ND       10      7      1      8      0      0      0      0      0      0      0
 3RD        9      5      5      5      0      0      0      0      0      0      0
 4TH        7      3      4     10      0      0      0      0      0      0      0
 5TH        2      6      8      9      0      0      0      0      0      0      0

PROP    (0.35) 0.19   0.16   0.29   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI    (0.34)-0.03  -0.23  -0.14   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 19   PERCENT OF CORRECT RESPONSE BY FIFTHS

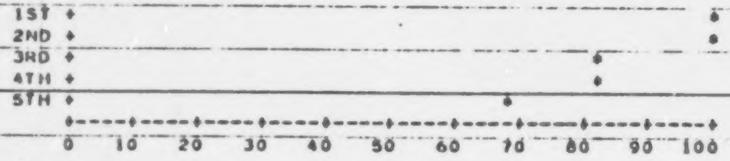


```
MATRIX OF RESPONSES BY FIFTHS                       C IS CORRECT RESPONSE

            A      B     (C)     D      E      F      G      H      I      J   OMIT
 1ST        3      0     18      4      6      0      0      0      0      0      0
 2ND        5      0     18      3      0      0      0      0      0      0      0
 3RD        8      1      5     10      0      0      0      0      0      0      0
 4TH        3      0      8     13      0      0      0      0      0      0      0
 5TH       11      1      2     11      0      0      0      0      0      0      0

PROP     0.24   0.02  (0.41) 0.33   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI    -0.17  -0.11  (0.48)-0.32   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 20   PERCENT OF CORRECT RESPONSE BY FIFTHS

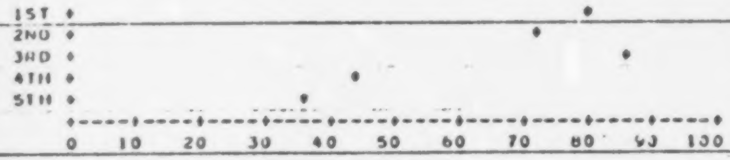


```
MATRIX OF RESPONSES BY FIFTHS                       C IS CORRECT RESPONSE

            A      B     (C)     D      E      F      G      H      I      J   OMIT
 1ST        0      0     25      0      0      0      0      0      0      0      0
 2ND        0      0     26      0      0      0      0      0      0      0      0
 3RD        0      2     20      2      0      0      0      0      0      0      0
 4TH        0      4     20      0      0      0      0      0      0      0      0
 5TH        0      7     17      1      0      0      0      0      0      0      0

PROP     0.00   0.10  (0.87) 0.02   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI     0.00  -0.31  (0.31)-0.07   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 21 PERCENT OF CORRECT RESPONSE BY FIFTHS

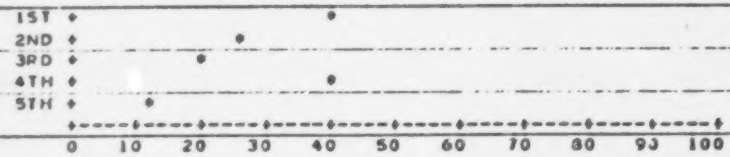


```
MATRIX OF RESPONSES BY FIFTHS                    C IS CORRECT RESPONSE

          A      B     (C)     D      E      F      G      H      I      J   OMIT
1ST       4      1     20      0      0      0      0      0      0      0      0
2ND       2      4     19      1      0      0      0      0      0      0      0
3RD       1      2     21      0      0      0      0      0      0      0      0
4TH       7      4     11      1      0      0      0      0      0      0      1
5TH       3      5      9      7      0      0      0      0      0      0      1

PROP   0.14   0.13 (0.65) 0.07   0.00   0.00   0.00   0.00   0.00   0.00   0.02
RPBI  -0.03  -0.14 (0.34)-0.34   0.00   0.00   0.00   0.00   0.00   0.00  -0.15
```

ITEM 22 PERCENT OF CORRECT RESPONSE BY FIFTHS

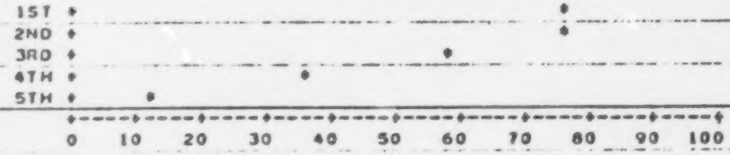


```
MATRIX OF RESPONSES BY FIFTHS                    A IS CORRECT RESPONSE

         (A)     B      C      D      E      F      G      H      I      J   OMIT
1ST      10     14      1      0      0      0      0      0      0      0      0
2ND       7     18      0      1      0      0      0      0      0      0      0
3RD       5     16      1      2      0      0      0      0      0      0      0
4TH      10     13      1      0      0      0      0      0      0      0      0
5TH       3     21      0      1      0      0      0      0      0      0      0

PROP  (0.28)  0.66   0.02   0.03   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI  (0.15) -0.12   0.04  -0.08   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 23 PERCENT OF CORRECT RESPONSE BY FIFTHS

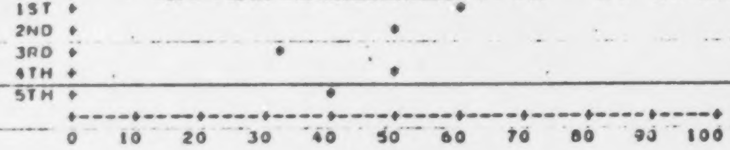


```
MATRIX OF RESPONSES BY FIFTHS                    A IS CORRECT RESPONSE

         (A)     B      C      D      E      F      G      H      I      J   OMIT
1ST      19      1      3      2      0      0      0      0      0      0      0
2ND      20      1      4      1      0      0      0      0      0      0      0
3RD      14      0      6      4      0      0      0      0      0      0      0
4TH       9      3      6      6      0      0      0      0      0      0      0
5TH       3      1     13      8      0      0      0      0      0      0      0

PROP  (0.52)  0.05   0.26   0.17   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI  (0.49) -0.05  -0.30  -0.26   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 24 PERCENT OF CORRECT RESPONSE BY FIFTHS



```
MATRIX OF RESPONSES BY FIFTHS                    C IS CORRECT RESPONSE

          A      B     (C)     D      E      F      G      H      I      J   OMIT
1ST       0     10     15      0      0      0      0      0      0      0      0
2ND       4      8     13      1      0      0      0      0      0      0      0
3RD       1     15      8      0      0      0      0      0      0      0      0
4TH       1      9     12      1      0      0      0      0      0      0      1
5TH       4      8     10      1      0      0      0      0      0      0      2

PROP   0.05   0.40 (0.47) 0.02   0.00   0.00   0.00   0.00   0.00   0.00   0.02
RPBI  -0.11   0.05 (0.10)-0.04   0.00   0.00   0.00   0.00   0.00   0.00  -0.24
```

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ITEM  25      PERCENT OF CORRECT RESPONSE BY FIFTHS                               MATRIX OF RESPONSES BY FIFTHS             A IS CORRECT RESPONSE

                                                                                         (A)     B     C     D     E     F     G     H     I     J  OMIT
    1ST +                                                       +                 1ST     20     3     0     2     0     0     0     0     0     0     0
    2ND +                                               +                         2ND     18     3     1     4     0     0     0     0     0     0     0
    3RD +                                     +                                   3RD     13     6     2     3     0     0     0     0     0     0     0
    4TH +                                     +                                   4TH     13     4     4     2     0     0     0     0     0     0     1
    5TH +                                   +                                     5TH     13     6     4     1     0     0     0     0     0     0     1
        +------+------+------+------+------+------+------+------+------+------+
        0      10     20     30     40     50     60     70     80     90     100 PROP  (0.62) 0.18  0.09  0.10  0.00  0.00  0.00  0.00  0.00  0.00  0.02
                                                                                  RPBI  (0.20)-0.09 -0.23  0.08  0.00  0.00  0.00  0.00  0.00  0.00 -0.17

ITEM  26      PERCENT OF CORRECT RESPONSE BY FIFTHS                               MATRIX OF RESPONSES BY FIFTHS             B IS CORRECT RESPONSE

                                                                                           A   (B)     C     D     E     F     G     H     I     J  OMIT
    1ST +                                                    +                    1ST      3    19     2     1     0     0     0     0     0     0     0
    2ND +                                         +                               2ND      8    16     1     1     0     0     0     0     0     0     0
    3RD +                                        +                                3RD      4    14     3     3     0     0     0     0     0     0     0
    4TH +                           +                                             4TH      6    10     6     2     0     0     0     0     0     0     0
    5TH +                                         +                               5TH      3    15     1     4     0     0     0     0     0     0     2
        +------+------+------+------+------+------+------+------+------+------+
        0      10     20     30     40     50     60     70     80     90     100 PROP   0.19 (0.60) 0.10  0.09  0.00  0.00  0.00  0.00  0.00  0.00  0.02
                                                                                  RPBI   0.02 (0.16)-0.05 -0.13  0.00  0.00  0.00  0.00  0.00  0.00 -0.25

ITEM  27      PERCENT OF CORRECT RESPONSE BY FIFTHS                               MATRIX OF RESPONSES BY FIFTHS             A IS CORRECT RESPONSE

                                                                                         (A)     B     C     D     E     F     G     H     I     J  OMIT
    1ST +                                                 +                       1ST     18     4     0     3     0     0     0     0     0     0     0
    2ND +                                      +                                  2ND     15     4     1     6     0     0     0     0     0     0     0
    3RD +                        +                                                3RD      9     9     0     6     0     0     0     0     0     0     0
    4TH +             +                                                           4TH      5     8     1    10     0     0     0     0     0     0     0
    5TH +  +                                                                      5TH      1    11     0    12     0     0     0     0     0     0     1
        +------+------+------+------+------+------+------+------+------+------+
        0      10     20     30     40     50     60     70     80     90     100 PROP  (0.39) 0.29  0.02  0.30  0.00  0.00  0.00  0.00  0.00  0.00  0.01
                                                                                  RPBI  (0.47)-0.19 -0.01 -0.28  0.00  0.00  0.00  0.00  0.00  0.00 -0.15

ITEM  28      PERCENT OF CORRECT RESPONSE BY FIFTHS                               MATRIX OF RESPONSES BY FIFTHS             C IS CORRECT RESPONSE

                                                                                           A     B   (C)     D     E     F     G     H     I     J  OMIT
    1ST +                                                          +              1ST      1     3    21     0     0     0     0     0     0     0     0
    2ND +                                         +                               2ND      4     5    16     1     0     0     0     0     0     0     0
    3RD +                                  +                                      3RD      5     5    12     2     0     0     0     0     0     0     0
    4TH +                     +                                                   4TH      2     7     8     7     0     0     0     0     0     0     0
    5TH +                              +                                          5TH      1     7    11     5     0     0     0     0     0     0     1
        +------+------+------+------+------+------+------+------+------+------+
        0      10     20     30     40     50     60     70     80     90     100 PROP   0.10  0.22 (0.55) 0.12  0.00  0.00  0.00  0.00  0.00  0.00  0.01
                                                                                  RPBI   0.05 -0.19 (0.32)-0.25  0.00  0.00  0.00  0.00  0.00  0.00 -0.20
```

FORM 1011-3

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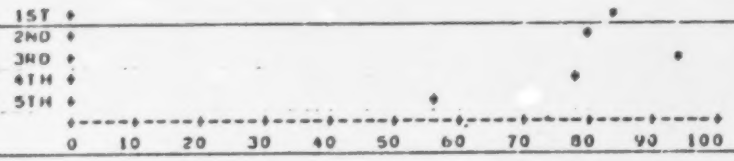
ITEM 29   PERCENT OF CORRECT RESPONSE BY FIFTHS

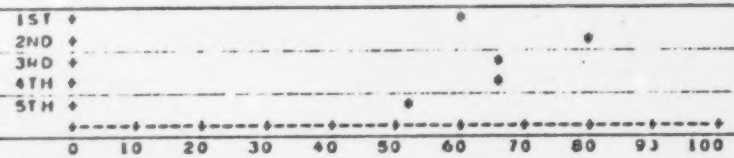


```
MATRIX OF RESPONSES BY FIFTHS                              B IS CORRECT RESPONSE

            A     (B)     C      D      E      F      G      H      I      J   OMIT
  1ST       0     21      1      3      0      0      0      0      0      0      0
  2ND       0     21      3      2      0      0      0      0      0      0      0
  3RD       0     23      0      1      0      0      0      0      0      0      0
  4TH       1     19      2      2      0      0      0      0      0      0      0
  5TH       1     14      4      6      0      0      0      0      0      0      0

 PROP    0.02  (0.79)  0.08   0.11   0.00   0.00   0.00   0.00   0.00   0.00   0.00
 RPBI   -0.15  (0.23)-0.12  -0.14   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 30   PERCENT OF CORRECT RESPONSE BY FIFTHS

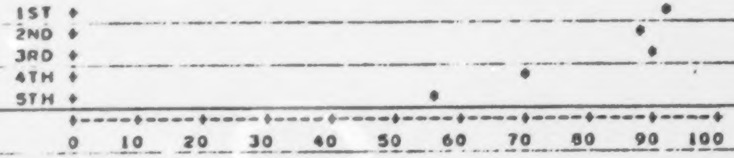


```
MATRIX OF RESPONSES BY FIFTHS                              C IS CORRECT RESPONSE

            A      B     (C)     D      E      F      G      H      I      J   OMIT
  1ST       1      1     15      6      0      0      0      0      0      0      0
  2ND       0      2     21      3      0      0      0      0      0      0      0
  3RD       3      2     16      3      0      0      0      0      0      0      0
  4TH       1      3     16      4      0      0      0      0      0      0      0
  5TH       6      5     13      1      0      0      0      0      0      0      0

 PROP    0.09   0.10  (0.65)  0.15   0.00   0.00   0.00   0.00   0.00   0.00   0.00
 RPBI   -0.23  -0.12  (0.08)  0.18   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 31   PERCENT OF CORRECT RESPONSE BY FIFTHS

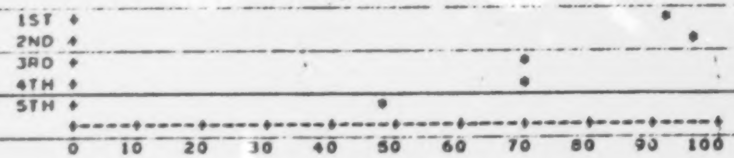


```
MATRIX OF RESPONSES BY FIFTHS                              D IS CORRECT RESPONSE

            A      B      C     (D)     E      F      G      H      I      J   OMIT
  1ST       1      0      1     23      0      0      0      0      0      0      0
  2ND       1      2      0     23      0      0      0      0      0      0      0
  3RD       1      0      1     22      0      0      0      0      0      0      0
  4TH       1      2      4     17      0      0      0      0      0      0      0
  5TH       4      2      5     14      0      0      0      0      0      0      0

 PROP    0.06   0.05   0.09  (0.80)  0.00   0.00   0.00   0.00   0.00   0.00   0.00
 RPBI   -0.12  -0.11  -0.23  (0.30)  0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 32   PERCENT OF CORRECT RESPONSE BY FIFTHS



```
MATRIX OF RESPONSES BY FIFTHS                              C IS CORRECT RESPONSE

            A      B     (C)     D      E      F      G      H      I      J   OMIT
  1ST       1      0     23      1      0      0      0      0      0      0      0
  2ND       1      0     25      0      0      0      0      0      0      0      0
  3RD       3      1     17      3      0      0      0      0      0      0      0
  4TH       6      1     17      0      0      0      0      0      0      0      0
  5TH       5      2     12      6      0      0      0      0      0      0      0

 PROP    0.13   0.03  (0.76)  0.08   0.00   0.00   0.00   0.00   0.00   0.00   0.00
 RPBI   -0.17  -0.16  (0.37)-0.26   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

```
ITEM  33      PERCENT OF CORRECT RESPONSE BY FIFTHS          MATRIX OF RESPONSES BY FIFTHS                 C IS CORRECT RESPONSE

                                                                       A      B     (C)     D      E      F      G      H      I      J   OMIT
      1ST +                                           *      1ST       1      1     22      1      0      0      0      0      0      0      0
      2ND +                                     *            2ND       1      0     20      5      0      0      0      0      0      0      0
      3RD +                               *                  3RD       2      1     16      6      0      0      0      0      0      0      0
      4TH +                            *                     4TH       2      1     14      7      0      0      0      0      0      0      0
      5TH +                     *                            5TH       2      2     11     10      0      0      0      0      0      0      0
          +----+----+----+----+----+----+----+----+----+----+
          0    10   20   30   40   50   60   70   80   90   100   PROP    0.06   0.04 (0.67)  0.23   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                                  RPBI   -0.08  -0.09 (0.32)-0.27   0.00   0.00   0.00   0.00   0.00   0.00   0.00

ITEM  34      PERCENT OF CORRECT RESPONSE BY FIFTHS          MATRIX OF RESPONSES BY FIFTHS                 A IS CORRECT RESPONSE

                                                                      (A)     B      C      D      E      F      G      H      I      J   OMIT
      1ST +                                   *              1ST      18      3      3      1      0      0      0      0      0      0      0
      2ND +                         *                        2ND      14      5      6      1      0      0      0      0      0      0      0
      3RD +                 *                                3RD       9     10      3      2      0      0      0      0      0      0      0
      4TH +                   *                              4TH      10     11      3      0      0      0      0      0      0      0      0
      5TH +           *                                      5TH       6     13      2      2      0      0      0      0      0      0      2
          +----+----+----+----+----+----+----+----+----+----+
          0    10   20   30   40   50   60   70   80   90   100   PROP  (0.46)  0.34   0.14   0.05   0.00   0.00   0.00   0.00   0.00   0.00   0.02
                                                                  RPBI  (0.32)-0.32   0.07   0.01   0.00   0.00   0.00   0.00   0.00   0.00  -0.25

ITEM  35      PERCENT OF CORRECT RESPONSE BY FIFTHS          MATRIX OF RESPONSES BY FIFTHS                 C IS CORRECT RESPONSE

                                                                       A      B     (C)     D      E      F      G      H      I      J   OMIT
      1ST +                               *                  1ST       5      1     16      3      0      0      0      0      0      0      0
      2ND +                                       *          2ND       2      2     21      1      0      0      0      0      0      0      0
      3RD +                                  *               3RD       3      2     17      2      0      0      0      0      0      0      0
      4TH +                        *                         4TH       5      5     12      2      0      0      0      0      0      0      0
      5TH +                               *                  5TH       2      3     16      3      0      0      0      0      0      0      1
          +----+----+----+----+----+----+----+----+----+----+
          0    10   20   30   40   50   60   70   80   90   100   PROP    0.14   0.10 (0.66)  0.09   0.00   0.00   0.00   0.00   0.00   0.00   0.01
                                                                  RPBI    0.04  -0.08 (0.09)-0.05   0.00   0.00   0.00   0.00   0.00   0.00  -0.15

ITEM  36      PERCENT OF CORRECT RESPONSE BY FIFTHS          MATRIX OF RESPONSES BY FIFTHS                 C IS CORRECT RESPONSE

                                                                       A      B     (C)     D      E      F      G      H      I      J   OMIT
      1ST +                                     *            1ST       0      0     19      6      0      0      0      0      0      0      0
      2ND +                                 *                2ND       0      0     18      8      0      0      0      0      0      0      0
      3RD +                                      *           3RD       1      0     19      4      0      0      0      0      0      0      0
      4TH +               *                                  4TH       1      1      8     14      0      0      0      0      0      0      0
      5TH +             *                                    5TH       8      3      7      7      0      0      0      0      0      0      0
          +----+----+----+----+----+----+----+----+----+----+
          0    10   20   30   40   50   60   70   80   90   100   PROP    0.08   0.03 (0.57)  0.31   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                                  RPBI   -0.41  -0.18 (0.38)-0.09   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

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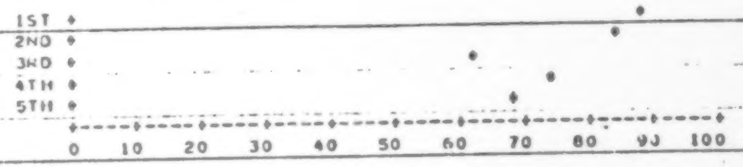
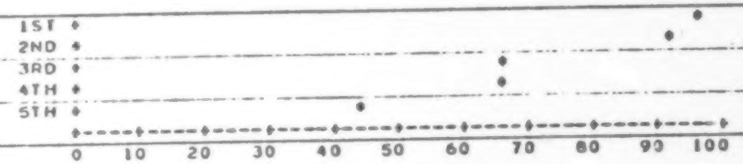
ITEM 37   PERCENT OF CORRECT RESPONSE BY FIFTHS



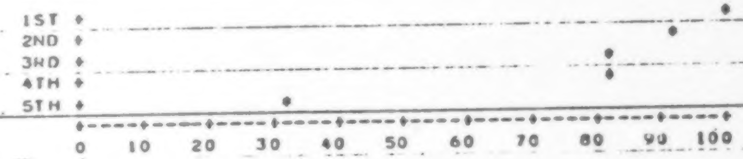
```
MATRIX OF RESPONSES BY FIFTHS                          A IS CORRECT RESPONSE

          (A)     B      C      D      E      F      G      H      I      J   OMIT
  1ST      22     0      2      1      0      0      0      0      0      0      0
  2ND      22     1      2      1      0      0      0      0      0      0      0
  3RD      15     0  [illegible] 4     0      0      0      0      0      0      0
  4TH      18     1      2      3      0      0      0      0      0      0      0
  5TH      17     3      3      2      0      0      0      0      0      0      0

  PROP  (0.76) 0.04   0.11   0.09   0.00   0.00   0.00   0.00   0.00   0.00   0.00
  RPBI  (0.14)-0.21  -0.03  -0.04   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 38   PERCENT OF CORRECT RESPONSE BY FIFTHS



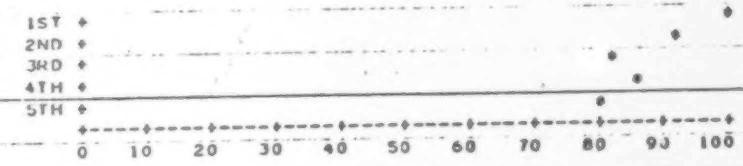
```
MATRIX OF RESPONSES BY FIFTHS                          B IS CORRECT RESPONSE

           A     (B)     C      D      E      F      G      H      I      J   OMIT
  1ST       1    24      0      0      0      0      0      0      0      0      0
  2ND       0    24      2      0      0      0      0      0      0      0      0
  3RD       0    16      7      1      0      0      0      0      0      0      0
  4TH       0    16      8      0      0      0      0      0      0      0      0
  5TH       0    11     13      1      0      0      0      0      0      0      0

  PROP   0.01  (0.73)  0.24   0.02   0.00   0.00   0.00   0.00   0.00   0.00   0.00
  RPBI   0.11  (0.43) -0.43  -0.12   0.03   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 39   PERCENT OF CORRECT RESPONSE BY FIFTHS



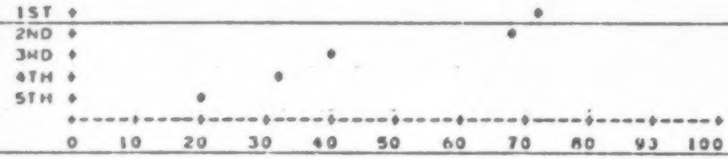
```
MATRIX OF RESPONSES BY FIFTHS                          A IS CORRECT RESPONSE

          (A)     B      C      D      E      F      G      H      I      J   OMIT
  1ST      25     0      0      0      0      0      0      0      0      0      0
  2ND      24     2      0      0      0      0      0      0      0      0      0
  3RD      20     4      0      0      0      0      0      0      0      0      0
  4TH      20     2      1      1      0      0      0      0      0      0      0
  5TH       8    12      2      3      0      0      0      0      0      0      0

  PROP  (0.78) 0.16   0.02   0.03   0.00   0.00   0.00   0.00   0.00   0.00   0.00
  RPBI  (0.54)-0.39  -0.19  -0.29   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 40   PERCENT OF CORRECT RESPONSE BY FIFTHS



```
MATRIX OF RESPONSES BY FIFTHS                          D IS CORRECT RESPONSE

           A      B      C     (D)     E      F      G      H      I      J   OMIT
  1ST       0     0      0     25      0      0      0      0      0      0      0
  2ND       1     0      1     24      0      0      0      0      0      0      0
  3RD       3     0      1     20      0      0      0      0      0      0      0
  4TH       1     1      1     21      0      0      0      0      0      0      0
  5TH       5     0      0     20      0      0      0      0      0      0      0

  PROP   0.08   0.01   0.02  (0.89)  0.00   0.00   0.00   0.00   0.00   0.00   0.00
  RPBI  -0.25  -0.05  -0.00  (0.23)  0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

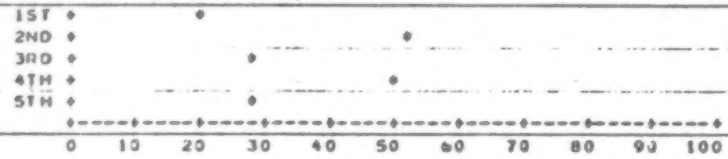
ITEM 41 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS A IS CORRECT RESPONSE

```
        (A)     B     C     D     E     F     G     H     I     J  OMIT
1ST      18     4     1     2     0     0     0     0     0     0     0
2ND      18     5     0     3     0     0     0     0     0     0     0
3RD      10    12     2     0     0     0     0     0     0     0     0
4TH       8    10     1     5     0     0     0     0     0     0     0
5TH       5     7     4     8     0     0     0     0     0     0     1

PROP (0.49) 0.31  0.06  0.15  0.00  0.00  0.00  0.00  0.00  0.00  0.01
RPBI (0.39)-0.11 -0.17 -0.23  0.00  0.00  0.00  0.00  0.00  0.00 -0.20
```

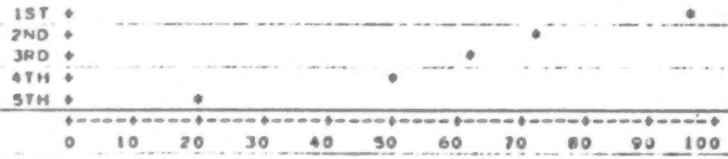
ITEM 42 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS C IS CORRECT RESPONSE

```
          A     B   (C)     D     E     F     G     H     I     J  OMIT
1ST      17     2     5     1     0     0     0     0     0     0     0
2ND       6     4    14     2     0     0     0     0     0     0     0
3RD       8     2     7     6     0     0     0     0     0     0     1
4TH       7     2    12     3     0     0     0     0     0     0     0
5TH       9     2     7     6     0     0     0     0     0     0     1

PROP   0.38  0.10 (0.36) 0.15  0.00  0.00  0.00  0.00  0.00  0.00  0.02
RPBI   0.15 -0.01 (0.00)-0.14  0.00  0.00  0.00  0.00  0.00  0.00 -0.16
```

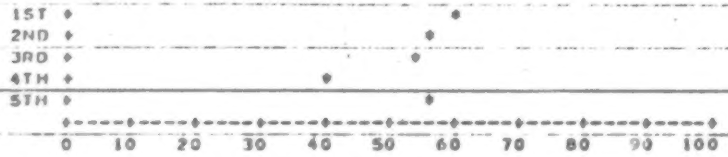
ITEM 43 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS A IS CORRECT RESPONSE

```
        (A)     B     C     D     E     F     G     H     I     J  OMIT
1ST      24     0     0     1     0     0     0     0     0     0     0
2ND      19     4     0     3     0     0     0     0     0     0     0
3RD      15     3     4     2     0     0     0     0     0     0     0
4TH      12     3     5     4     0     0     0     0     0     0     0
5TH       5     5     5     9     0     0     0     0     0     0     1

PROP (0.60) 0.12  0.11  0.15  0.00  0.00  0.00  0.00  0.00  0.00  0.01
RPBI (0.51)-0.18 -0.23 -0.29  0.00  0.00  0.00  0.00  0.00  0.00 -0.15
```

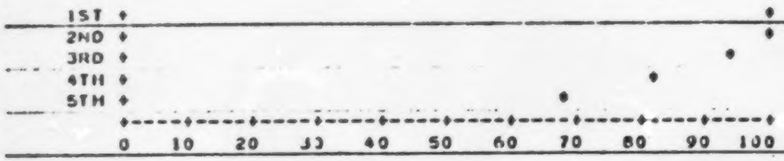
ITEM 44 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS C IS CORRECT RESPONSE

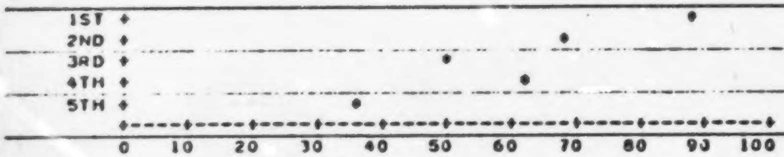
```
          A     B   (C)     D     E     F     G     H     I     J  OMIT
1ST       0     9    15     1     0     0     0     0     0     0     0
2ND       1    10    15     0     0     0     0     0     0     0     0
3RD       2     9    13     0     0     0     0     0     0     0     0
4TH       0    12    10     2     0     0     0     0     0     0     0
5TH       1     9    14     0     0     0     0     0     0     0     1

PROP   0.03  0.40 (0.54) 0.02  0.00  0.00  0.00  0.00  0.00  0.00  0.01
RPBI  -0.08  0.01 (0.06) 0.00  0.00  0.00  0.00  0.00  0.00  0.00 -0.20
```

ITEM 45 PERCENT OF CORRECT RESPONSE BY FIFTHS



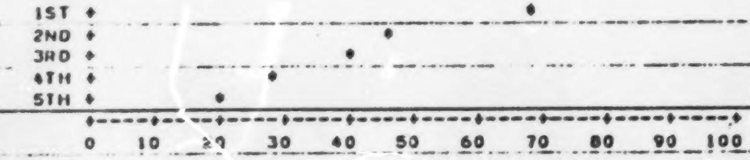
```
MATRIX OF RESPONSES BY FIFTHS                    B IS CORRECT RESPONSE

          A     (B)     C      D      E      F      G      H      I      J  OMIT
 1ST      0     25      0      0      0      0      0      0      0      0     0
 2ND      0     26      0      0      0      0      0      0      0      0     0
 3RD      1     23      0      0      0      0      0      0      0      0     0
 4TH      2     20      0      2      0      0      0      0      0      0     0
 5TH      5     17      0      3      0      0      0      0      0      0     0

PROP   0.05 (0.90) 0.00   0.04   0.00   0.00   0.00   0.00   0.00   0.00  0.00
RPBI  -0.32 (0.40) 0.00  -0.22   0.00   0.00   0.00   0.00   0.00   0.00  0.00
```

ITEM 46 PERCENT OF CORRECT RESPONSE BY FIFTHS



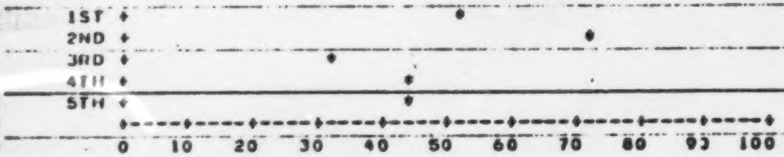
```
MATRIX OF RESPONSES BY FIFTHS                    C IS CORRECT RESPONSE

          A      B     (C)     D      E      F      G      H      I      J  OMIT
 1ST      1      0     22      2      0      0      0      0      0      0     0
 2ND      0      0     18      8      0      0      0      0      0      0     0
 3RD      4      1     12      7      0      0      0      0      0      0     0
 4TH      1      1     15      7      0      0      0      0      0      0     0
 5TH      5      3      9      8      0      0      0      0      0      0     0

PROP   0.09   0.04  (0.61) 0.26   0.00   0.00   0.00   0.00   0.00   0.00  0.00
RPBI  -0.24  -0.20  (0.36)-0.16   0.00   0.00   0.00   0.00   0.00   0.00  0.00
```

ITEM 47 PERCENT OF CORRECT RESPONSE BY FIFTHS



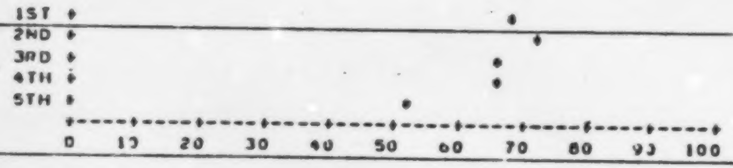
```
MATRIX OF RESPONSES BY FIFTHS                    B IS CORRECT RESPONSE

          A     (B)     C      D      E      F      G      H      I      J  OMIT
 1ST      4     17      4      0      0      0      0      0      0      0     0
 2ND      5     12      5      4      0      0      0      0      0      0     0
 3RD      6     10      4      4      0      0      0      0      0      0     0
 4TH      3      7      6      8      0      0      0      0      0      0     0
 5TH     10      5      4      4      0      0      0      0      0      0     2

PROP   0.23 (0.41) 0.19   0.16   0.00   0.00   0.00   0.00   0.00   0.00  0.02
RPBI  -0.19 (0.35) 0.00  -0.17   0.00   0.00   0.00   0.00   0.00   0.00 -0.25
```

ITEM 48 PERCENT OF CORRECT RESPONSE BY FIFTHS



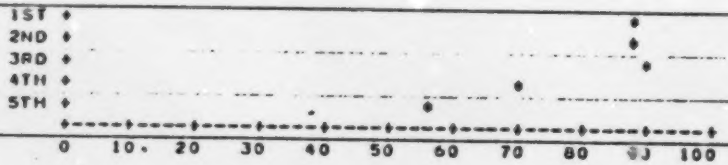
```
MATRIX OF RESPONSES BY FIFTHS                    A IS CORRECT RESPONSE

         (A)     B      C      D      E      F      G      H      I      J  OMIT
 1ST     13      8      4      0      0      0      0      0      0      0     0
 2ND     19      4      3      0      0      0      0      0      0      0     0
 3RD      8      8      5      3      0      0      0      0      0      0     0
 4TH     11      4      7      2      0      0      0      0      0      0     0
 5TH     11      9      3      1      0      0      0      0      0      0     1

PROP  (0.50) 0.27   0.18   0.05   0.00   0.00   0.00   0.00   0.00   0.00  0.01
RPBI  (0.11)-0.02  -0.01  -0.11   0.00   0.00   0.00   0.00   0.00   0.00 -0.20
```

ITEM 49 PERCENT OF CORRECT RESPONSE BY FIFTHS



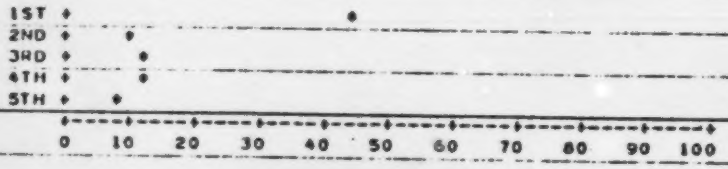
```
MATRIX OF RESPONSES BY FIFTHS                    D IS CORRECT RESPONSE

           A      B      C     (D)     E      F      G      H      I      J   OMIT
 1ST       8      0      0     17      0      0      0      0      0      0      0
 2ND       5      1      1     19      0      0      0      0      0      0      0
 3RD       6      0      2     16      0      0      0      0      0      0      0
 4TH       6      0      2     16      0      0      0      0      0      0      0
 5TH       9      2      1     13      0      0      0      0      0      0      0

PROP    0.27   0.02   0.05 (0.65)  0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI   -0.07  -0.16  -0.08 (0.15)  0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 50 PERCENT OF CORRECT RESPONSE BY FIFTHS



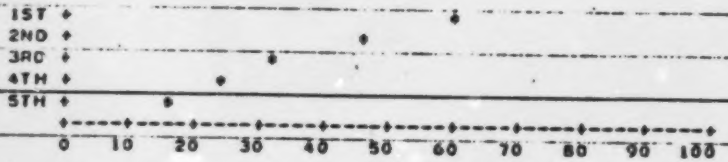
```
MATRIX OF RESPONSES BY FIFTHS                    B IS CORRECT RESPONSE

           A     (B)     C      D      E      F      G      H      I      J   OMIT
 1ST       2     22      0      1      0      0      0      0      0      0      0
 2ND       1     23      1      1      0      0      0      0      0      0      0
 3RD       0     22      1      1      0      0      0      0      0      0      0
 4TH       3     17      0      4      0      0      0      0      0      0      0
 5TH       5     14      2      3      0      0      0      0      0      0      1

PROP    0.09 (0.79)  0.03   0.08   0.00   0.00   0.00   0.00   0.00   0.00   0.01
RPBI   -0.20 (0.30)-0.09  -0.12   0.00   0.00   0.00   0.00   0.00   0.00  -0.20
```

ITEM 51 PERCENT OF CORRECT RESPONSE BY FIFTHS



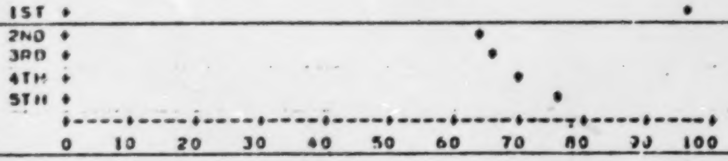
```
MATRIX OF RESPONSES BY FIFTHS                    A IS CORRECT RESPONSE

          (A)     B      C      D      E      F      G      H      I      J   OMIT
 1ST      11      9      3      2      0      0      0      0      0      0      0
 2ND       3     15      7      1      0      0      0      0      0      0      0
 3RD       3     17      4      0      0      0      0      0      0      0      0
 4TH       3     14      4      3      0      0      0      0      0      0      0
 5TH       2      9      7      6      0      0      0      0      0      0      1

PROP   (0.18)  0.52   0.20   0.10   0.00   0.00   0.00   0.00   0.00   0.00   0.01
RPBI   (0.26)  0.03  -0.07  -0.24   0.00   0.00   0.00   0.00   0.00   0.00  -0.20
```

ITEM 52 PERCENT OF CORRECT RESPONSE BY FIFTHS



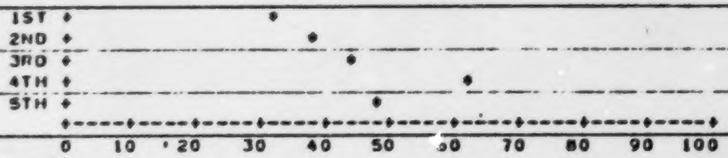
```
MATRIX OF RESPONSES BY FIFTHS                    C IS CORRECT RESPONSE

           A      B     (C)     D      E      F      G      H      I      J   OMIT
 1ST       7      2     15      1      0      0      0      0      0      0      0
 2ND      10      4     12      0      0      0      0      0      0      0      0
 3RD      11      3      8      2      0      0      0      0      0      0      0
 4TH      10      7      6      1      0      0      0      0      0      0      0
 5TH      11      7      4      2      0      0      0      0      0      0      1

PROP    0.40   0.19 (0.36)  0.05   0.00   0.00   0.00   0.00   0.00   0.00   0.01
RPBI   -0.13  -0.17 (0.33)-0.06   0.00   0.00   0.00   0.00   0.00   0.00  -0.20
```

```
ITEM  53      PERCENT OF CORRECT RESPONSE BY FIFTHS
```



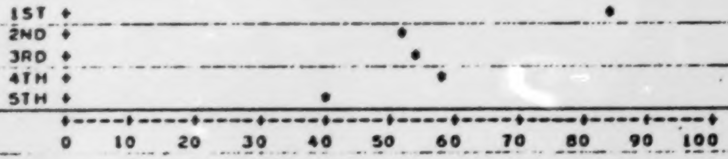
```
MATRIX OF RESPONSES BY FIFTHS                         C IS CORRECT RESPONSE

           A      B     (C)     D      E      F      G      H      I      J   OMIT
 1ST       0      1     24      0      0      0      0      0      0      0      0
 2ND       0      7     17      2      0      0      0      0      0      0      0
 3RD       0      8     16      0      0      0      0      0      0      0      0
 4TH       0      5     17      2      0      0      0      0      0      0      0
 5TH       1      4     19      1      0      0      0      0      0      0      0

PROP    0.01   0.20 (0.75) 0.04   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI   -0.10  -0.06 (0.09)-0.02   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

```
ITEM  54      PERCENT OF CORRECT RESPONSE BY FIFTHS
```



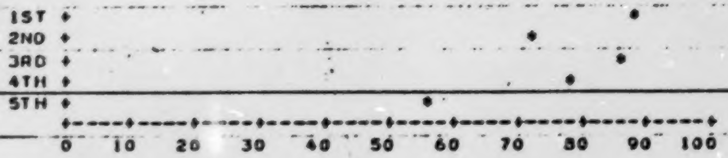
```
MATRIX OF RESPONSES BY FIFTHS                         D IS CORRECT RESPONSE

           A      B      C     (D)     E      F      G      H      I      J   OMIT
 1ST       3     12      2      8      0      0      0      0      0      0      0
 2ND       1     14 [illegible] 10     0      0      0      0      0      0      0
 3RD       3      7 [illegible] 11     0      0      0      0      0      0      0
 4TH       3      5 [illegible] 15     0      0      0      0      0      0      0
 5TH       2     10      1     12      0      0      0      0      0      0      0

PROP    0.10   0.39   0.06 (0.45) 0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI   -0.01   0.14   0.05 (0.15) 0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

```
ITEM  55      PERCENT OF CORRECT RESPONSE BY FIFTHS
```



```
MATRIX OF RESPONSES BY FIFTHS                         A IS CORRECT RESPONSE

          (A)     B      C      D      E      F      G      H      I      J   OMIT
 1ST      21      3      0      1      0      0      0      0      0      0      0
 2ND      14      4      5      3      0      0      0      0      0      0      0
 3RD      13      3      4      4      0      0      0      0      0      0      0
 4TH      14      5      5      0      0      0      0      0      0      0      0
 5TH      10     10      3      1      0      0      0      0      0      0      1

PROP   (0.58) 0.20   0.14   0.07   0.00   0.00   0.00   0.00   0.00   0.00   0.01
RPBI   (0.23)-0.22  -0.08   0.08   0.00   0.00   0.00   0.00   0.00   0.00  -0.20
```

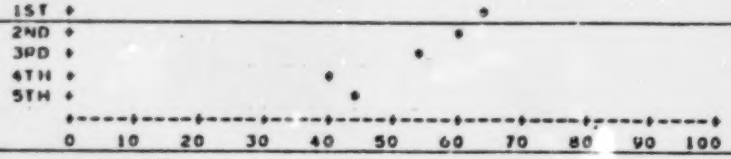
```
ITEM  56      PERCENT OF CORRECT RESPONSE BY FIFTHS
```



```
MATRIX OF RESPONSES BY FIFTHS                         B IS CORRECT RESPONSE

           A     (B)     C      D      E      F      G      H      I      J   OMIT
 1ST       1     22      0      2      0      0      0      0      0      0      0
 2ND       3     19      1      3      0      0      0      0      0      0      0
 3RD       2     21      0      1      0      0      0      0      0      0      0
 4TH       3     19      0      1      0      0      0      0      0      0      1
 5TH       3     14      3      5      0      0      0      0      0      0      0

PROP    0.10  (0.77) 0.03   0.10   0.00   0.00   0.00   0.00   0.00   0.00   0.01
RPBI   -0.07  (0.22)-0.16  -0.14   0.00   0.00   0.00   0.00   0.00   0.00  -0.06
```

ITEM 57

PERCENT OF CORRECT RESPONSE BY FIFTHS



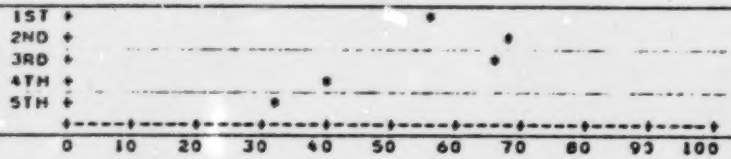
MATRIX OF RESPONSES BY FIFTHS

A IS CORRECT RESPONSE

	(A)	B	C	D	E	F	G	H	I	J	OMIT
1ST	15	0	0	9	0	0	0	0	0	0	0
2ND	16	0	1	8	0	0	0	0	0	0	1
3RD	13	0	0	11	0	0	0	0	0	0	0
4TH	13	1	1	12	0	0	0	0	0	0	0
5TH	11	1	2	11	0	0	0	0	0	0	0
PROP	(0.51)	0.02	0.03	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.01
RPBI	(0.17)	-0.11	-0.13	-0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.05

ITEM 58

PERCENT OF CORRECT RESPONSE BY FIFTHS



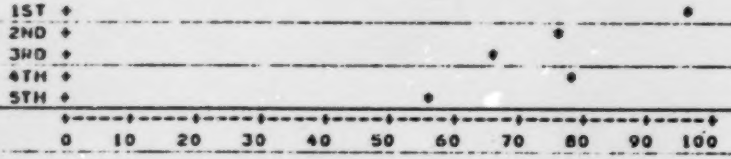
MATRIX OF RESPONSES BY FIFTHS

C IS CORRECT RESPONSE

	A	B	(C)	D	E	F	G	H	I	J	OMIT
1ST	1	7	14	3	0	0	0	0	0	0	0
2ND	0	5	18	3	0	0	0	0	0	0	0
3RD	5	3	16	0	0	0	0	0	0	0	0
4TH	11	2	10	1	0	0	0	0	0	0	0
5TH	11	4	8	2	0	0	0	0	0	0	0
PROP	0.23	0.17	(0.53)	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.43	0.11	(0.23)	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ITEM 59

PERCENT OF CORRECT RESPONSE BY FIFTHS



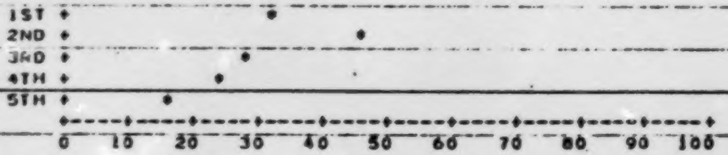
MATRIX OF RESPONSES BY FIFTHS

C IS CORRECT RESPONSE

	A	B	(C)	D	E	F	G	H	I	J	OMIT
1ST	0	0	24	1	0	0	0	0	0	0	0
2ND	1	0	20	5	0	0	0	0	0	0	0
3RD	0	0	16	8	0	0	0	0	0	0	0
4TH	1	0	19	4	0	0	0	0	0	0	0
5TH	2	4	14	5	0	0	0	0	0	0	0
PROP	0.03	0.03	(0.75)	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.12	-0.28	(0.25)	-0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ITEM 60

PERCENT OF CORRECT RESPONSE BY FIFTHS

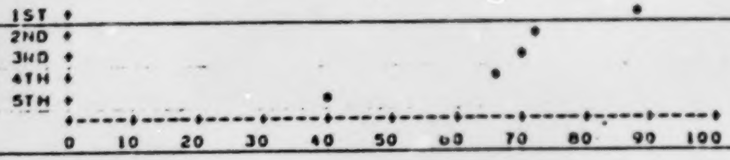


MATRIX OF RESPONSES BY FIFTHS

C IS CORRECT RESPONSE

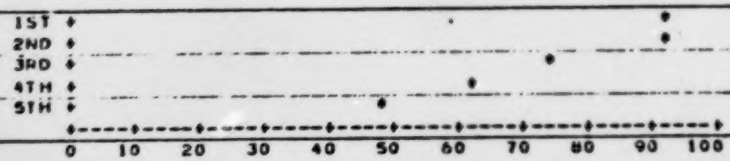
	A	B	(C)	D	E	F	G	H	I	J	OMIT
1ST	2	12	8	3	0	0	0	0	0	0	0
2ND	1	9	12	4	0	0	0	0	0	0	0
3RD	1	6	7	10	0	0	0	0	0	0	0
4TH	0	3	6	13	0	0	0	0	0	0	2
5TH	1	7	4	11	0	0	0	0	0	0	2
PROP	0.04	0.30	(0.30)	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.03
RPBI	0.11	0.16	(0.16)	-0.27	0.00	0.00	0.00	0.00	0.00	0.00	-0.23

ITEM 61   PERCENT OF CORRECT RESPONSE BY FIFTHS



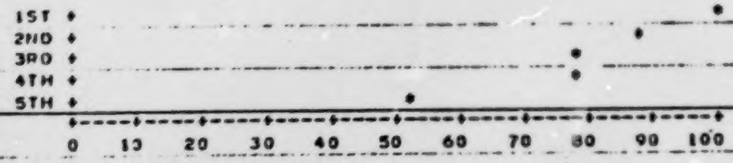
```
MATRIX OF RESPONSES BY FIFTHS                     C IS CORRECT RESPONSE

           A      B     (C)     D      E      F      G      H      I      J   OMIT
 1ST       0      2     22      1      0      0      0      0      0      0      0
 2ND       0      5     19      2      0      0      0      0      0      0      0
 3RD       0      6     17      1      0      0      0      0      0      0      0
 4TH       1      6     16      1      0      0      0      0      0      0      0
 5TH       5      8     10      2      0      0      0      0      0      0      0

PROP    0.05   0.22 (0.68)  0.06   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI   -0.30  -0.22 (0.32)  0.01   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 62   PERCENT OF CORRECT RESPONSE BY FIFTHS



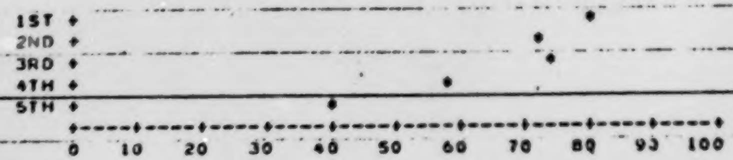
```
MATRIX OF RESPONSES BY FIFTHS                     B IS CORRECT RESPONSE

           A     (B)     C      D      E      F      G      H      I      J   OMIT
 1ST       2     23      0      0      0      0      0      0      0      0      0
 2ND       2     24      0      0      0      0      0      0      0      0      0
 3RD       3     18      1      2      0      0      0      0      0      0      0
 4TH       5     15      0      4      0      0      0      0      0      0      0
 5TH      10     12      1      2      0      0      0      0      0      0      0

PROP    0.18 (0.74)  0.02   0.06   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI   -0.29 (0.36)-0.09  -0.14   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 63   PERCENT OF CORRECT RESPONSE BY FIFTHS



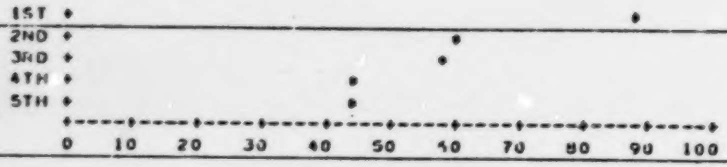
```
MATRIX OF RESPONSES BY FIFTHS                     B IS CORRECT RESPONSE

           A     (B)     C      D      E      F      G      H      I      J   OMIT
 1ST       0     25      0      0      0      0      0      0      0      0      0
 2ND       0     23      0      3      0      0      0      0      0      0      0
 3RD       0     19      2      3      0      0      0      0      0      0      0
 4TH       0     19      2      3      0      0      0      0      0      0      0
 5TH       2     13      3      6      0      0      0      0      0      0      1

PROP    0.02 (0.80)  0.06   0.12   0.00   0.00   0.00   0.00   0.00   0.00   0.01
RPBI   -0.21 (0.39)-0.18  -0.22   0.00   0.00   0.00   0.00   0.00   0.00  -0.20
```

ITEM 64   PERCENT OF CORRECT RESPONSE BY FIFTHS



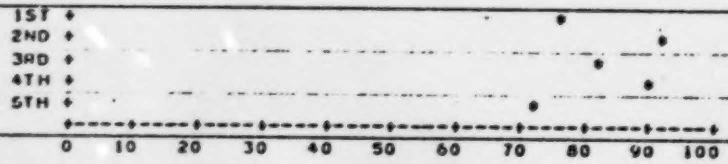
```
MATRIX OF RESPONSES BY FIFTHS                     B IS CORRECT RESPONSE

           A     (B)     C      D      E      F      G      H      I      J   OMIT
 1ST       0     20      1      4      0      0      0      0      0      0      0
 2ND       0     19      2      5      0      0      0      0      0      0      0
 3RD       1     18      2      3      0      0      0      0      0      0      0
 4TH       1     14      6      3      0      0      0      0      0      0      0
 5TH       2     10      3      9      0      0      0      0      0      0      1

PROP    0.03 (0.65)  0.11   0.19   0.00   0.00   0.00   0.00   0.00   0.00   0.01
RPBI   -0.13 (0.27)-0.11  -0.15   0.00   0.00   0.00   0.00   0.00   0.00  -0.15
```

```
ITEM  65       PERCENT OF CORRECT RESPONSE BY FIFTHS
```



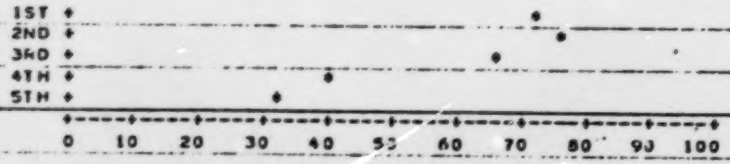
```
MATRIX OF RESPONSES BY FIFTHS                              D IS CORRECT RESPONSE

          A      B      C     (D)     E      F      G      H      I      J   OMIT
 1ST      2      0      1     22      0      0      0      0      0      0      0
 2ND      3      1      6     16      0      0      0      0      0      0      0
 3RD      3      3      3     14      0      0      0      0      0      0      1
 4TH      2      3      8     11      0      0      0      0      0      0      0
 5TH      2      1     11     11      0      0      0      0      0      0      0

PROP   0.10   0.06   0.23 (0.60)  0.00   0.00   0.00   0.00   0.00   0.00   0.01
RPBI   0.01  -0.09  -0.33 (0.33)  0.00   0.00   0.00   0.00   0.00   0.00  -0.01
```

```
ITEM  66       PERCENT OF CORRECT RESPONSE BY FIFTHS
```



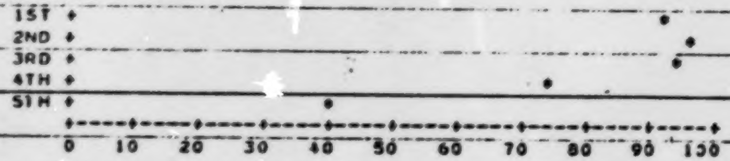
```
MATRIX OF RESPONSES BY FIFTHS                              A IS CORRECT RESPONSE

         (A)     B      C      D      E      F      G      H      I      J   OMIT
 1ST     19      2      3      1      0      0      0      0      0      0      0
 2ND     24      0      2      0      0      0      0      0      0      0      0
 3RD     20      3      1      0      0      0      0      0      0      0      0
 4TH     22      1      1      0      0      0      0      0      0      0      0
 5TH     18      1      5      1      0      0      0      0      0      0      0

PROP  (0.83)  0.06   0.10   0.02   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI  (0.02)  0.01  -0.04   0.02   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

```
ITEM  67       PERCENT OF CORRECT RESPONSE BY FIFTHS
```



```
MATRIX OF RESPONSES BY FIFTHS                              C IS CORRECT RESPONSE

          A      B     (C)     D      E      F      G      H      I      J   OMIT
 1ST      7      0     18      0      0      0      0      0      0      0      0
 2ND      5      1     20      0      0      0      0      0      0      0      0
 3RD      5      0     16      0      0      0      0      0      0      0      0
 4TH      8      6     10      0      0      0      0      0      0      0      0
 5TH     10      6      8      0      0      0      0      0      0      0      1

PROP   0.31   0.10 (0.58)  0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.01
RPBI  -0.12  -0.33 (0.36)  0.00   0.00   0.00   0.00   0.00   0.00   0.00  -0.20
```

```
ITEM  68       PERCENT OF CORRECT RESPONSE BY FIFTHS
```



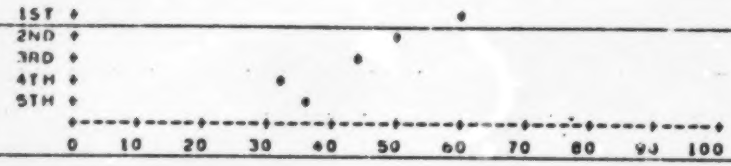
```
MATRIX OF RESPONSES BY FIFTHS                              B IS CORRECT RESPONSE

          A     (B)     C      D      E      F      G      H      I      J   OMIT
 1ST      1     23      0      1      0      0      0      0      0      0      0
 2ND      0     25      1      0      0      0      0      0      0      0      0
 3RD      1     23      0      0      0      0      0      0      0      0      0
 4TH      3     18      3      0      0      0      0      0      0      0      0
 5TH     11     10      0      2      0      0      0      0      0      0      2

PROP   0.13 (0.80)  0.03   0.02   0.00   0.00   0.00   0.00   0.00   0.00   0.02
RPBI  -0.36 (0.47)-0.08  -0.14   0.00   0.00   0.00   0.00   0.00   0.00  -0.25
```

490

491

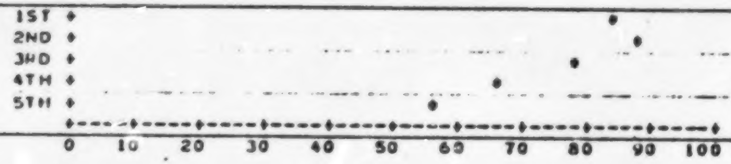
```
ITEM  69      PERCENT OF CORRECT RESPONSE BY FIFTHS             MATRIX OF RESPONSES BY FIFTHS                    C IS CORRECT RESPONSE

                                                                           A      B    (C)      D      E      F      G      H      I      J   OMIT
    1ST +                                                 *     1ST        0      0     25      0      0      0      0      0      0      0      0
    2ND +                                             *         2ND        2      0     24      0      0      0      0      0      0      0      0
    3RD +                                      *                3RD        4      0     19      1      0      0      0      0      0      0      0
    4TH +                                        *              4TH        3      0     20      1      0      0      0      0      0      0      0
    5TH +                   *                                   5TH       12      1     10      2      0      0      0      0      0      0      0
        +----+----+----+----+----+----+----+----+----+----+
        0    10   20   30   40   50   60   70   80   90  100    PROP    0.17   0.01  (0.79)  0.03   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                                RPBI   -0.39  -0.17  (0.46) -0.15   0.00   0.00   0.00   0.00   0.00   0.00   0.00

ITEM  70      PERCENT OF CORRECT RESPONSE BY FIFTHS             MATRIX OF RESPONSES BY FIFTHS                    D IS CORRECT RESPONSE

                                                                           A      B      C    (D)      E      F      G      H      I      J   OMIT
    1ST +                                     *                 1ST        2      4      0     19      0      0      0      0      0      0      0
    2ND +                         *                             2ND        1      7      4     14      0      0      0      0      0      0      0
    3RD +                                  *                    3RD        2      3      1     17      0      0      0      0      0      0      1
    4TH +                              *                        4TH        4      4      1     15      0      0      0      0      0      0      0
    5TH +                           *                           5TH        3      5      2     14      0      0      0      0      0      0      1
        +----+----+----+----+----+----+----+----+----+----+
        0    10   20   30   40   50   60   70   80   90  100    PROP    0.10   0.19   0.06  (0.64)  0.00   0.00   0.00   0.00   0.00   0.00   0.02
                                                                RPBI   -0.08  -0.00  -0.04  (0.10)  0.00   0.00   0.00   0.00   0.00   0.00  -0.11

ITEM  71      PERCENT OF CORRECT RESPONSE BY FIFTHS             MATRIX OF RESPONSES BY FIFTHS                    C IS CORRECT RESPONSE

                                                                           A      B    (C)      D      E      F      G      H      I      J   OMIT
    1ST +                                               *       1ST        1      0     24      0      0      0      0      0      0      0      0
    2ND +                                                 *     2ND        0      0     26      0      0      0      0      0      0      0      0
    3RD +                                        *              3RD        6      3     20      1      0      0      0      0      0      0      0
    4TH +                                          *            4TH        3      0     21      6      0      0      0      0      0      0      0
    5TH +                                       *               5TH        2      0     20      3      0      0      0      0      0      0      0
        +----+----+----+----+----+----+----+----+----+----+
        0    10   20   30   40   50   60   70   80   90  100    PROP    0.05   0.02  (0.90)  0.03   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                                RPBI   -0.13   0.02  (0.19) -0.19   0.00   0.00   0.00   0.00   0.00   0.00   0.00

ITEM  72      PERCENT OF CORRECT RESPONSE BY FIFTHS             MATRIX OF RESPONSES BY FIFTHS                    B IS CORRECT RESPONSE

                                                                           A    (B)      C      D      E      F      G      H      I      J   OMIT
    1ST +                                    *                  1ST        5     19      1      0      0      0      0      0      0      0      0
    2ND +                                    *                  2ND        1     20      2      3      0      0      0      0      0      0      0
    3RD +                          *                            3RD        3     13      4      4      0      0      0      0      0      0      0
    4TH +                 *                                     4TH        3      9      8      4      0      0      0      0      0      0      0
    5TH +             *                                         5TH        2      7      8      6      0      0      0      0      0      0      2
        +----+----+----+----+----+----+----+----+----+----+
        0    10   20   30   40   50   60   70   80   90  100    PROP    0.11  (0.55)  0.19   0.14   0.00   0.00   0.00   0.00   0.00   0.00   0.02
                                                                RPBI    0.07  (0.43) -0.29  -0.27   0.00   0.00   0.00   0.00   0.00   0.00  -0.25
```

ITEM 73   PERCENT OF CORRECT RESPONSE BY FIFTHS



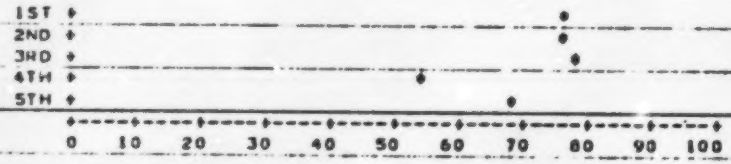
```
MATRIX OF RESPONSES BY FIFTHS                    D IS CORRECT RESPONSE

         A      B      C     (D)     E      F      G      H      I      J   OMIT
 1ST     5      4      1     16      0      0      0      0      0      0      0
 2ND     5      6      2     13      0      0      0      0      0      0      0
 3RD     9      3      1     11      0      0      0      0      0      0      0
 4TH     7      6      3      8      0      0      0      0      0      0      0
 5TH     4      8      3      9      0      0      0      0      0      0      1

PROP   0.24   0.22   0.08 (0.45)  0.00   0.00   0.00   0.00   0.00   0.00   0.01
RPBI   0.02  -0.12  -0.10 (0.16)  0.00   0.00   0.00   0.00   0.00   0.00  -0.20
```

ITEM 74   PERCENT OF CORRECT RESPONSE BY FIFTHS



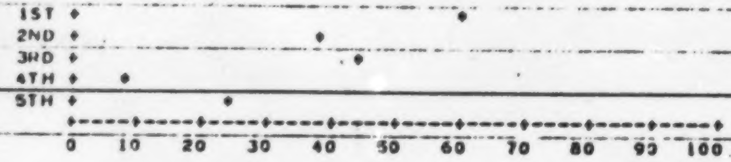
```
MATRIX OF RESPONSES BY FIFTHS                    B IS CORRECT RESPONSE

         A     (B)     C      D      E      F      G      H      I      J   OMIT
 1ST     2     21      2      0      0      0      0      0      0      0      0
 2ND     1     23      2      0      0      0      0      0      0      0      0
 3RD     2     19      2      0      0      0      0      0      0      0      1
 4TH     6     16      1      1      0      0      0      0      0      0      0
 5TH    10     14      0      1      0      0      0      0      0      0      0

PROP   0.17 (0.75)  0.06   0.02   0.00   0.00   0.00   0.00   0.00   0.00   0.01
RPBI  -0.35 (0.28)  0.11  -0.14   0.00   0.00   0.00   0.00   0.00   0.00   0.03
```

ITEM 75   PERCENT OF CORRECT RESPONSE BY FIFTHS



```
MATRIX OF RESPONSES BY FIFTHS                    A IS CORRECT RESPONSE

        (A)     B      C      D      E      F      G      H      I      J   OMIT
 1ST    19      1      2      3      0      0      0      0      0      0      0
 2ND    20      1      3      2      0      0      0      0      0      0      0
 3RD    19      1      4      0      0      0      0      0      0      0      0
 4TH    13      2      7      2      0      0      0      0      0      0      0
 5TH    17      2      5      1      0      0      0      0      0      0      0

PROP  (0.71)  0.06   0.17   0.06   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI  (0.14) -0.12  -0.16   0.10   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

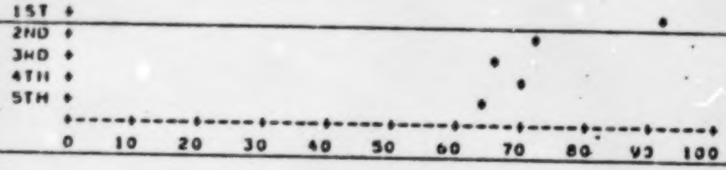
ITEM 76   PERCENT OF CORRECT RESPONSE BY FIFTHS



```
MATRIX OF RESPONSES BY FIFTHS                    C IS CORRECT RESPONSE

         A      B     (C)     D      E      F      G      H      I      J   OMIT
 1ST     3      4     15      3      0      0      0      0      0      0      0
 2ND     3      6     10      5      2      0      0      0      0      0      0
 3RD     4      4     11      4      0      0      0      0      0      0      1
 4TH     7      8      2      6      1      0      0      0      0      0      0
 5TH     4      7      6      6      2      0      0      0      0      0      0

PROP   0.17   0.23 (0.35)  0.19   0.04   0.00   0.00   0.00   0.00   0.00   0.01
RPBI  -0.09  -0.09 (0.27) -0.09  -0.12   0.00   0.00   0.00   0.00   0.00   0.03
```

```
ITEM  77     PERCENT OF CORRECT RESPONSE BY FIFTHS                    MATRIX OF RESPONSES BY FIFTHS                    D IS CORRECT RESPONSE

                                                                            A      B      C    (D)      E      F      G      H      I      J   OMIT
  1ST +                                             *                 1ST         0      2      4     19      0      0      0      0      0      0      0
  2ND +                                     *                         2ND         5      2      2     17      0      0      0      0      0      0      0
  3RD +                     *                                         3RD         7      4      4      9      0      0      0      0      0      0      0
  4TH +                         *                                     4TH         9      0      4     11      0      0      0      0      0      0      0
  5TH +                     *                                         5TH        11      2      3      9      0      0      0      0      0      0      0
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      0    10    20    30    40    50    60    70    80    90   100   PROP      0.26   0.08   0.14 (0.52)  0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                                      RPBI     -0.30   0.04   0.02 (0.30)  0.00   0.00   0.00   0.00   0.00   0.00   0.00


ITEM  78     PERCENT OF CORRECT RESPONSE BY FIFTHS                    MATRIX OF RESPONSES BY FIFTHS                    A IS CORRECT RESPONSE

                                                                          (A)      B      C      D      E      F      G      H      I      J   OMIT
  1ST +                                                 *             1ST        21      1      0      3      0      0      0      0      0      0      0
  2ND +                                        *                      2ND        18      2      1      5      0      0      0      0      0      0      0
  3RD +                                    *                          3RD        15      3      0      6      0      0      0      0      0      0      0
  4TH +                          *                                    4TH        11      7      1      5      0      0      0      0      0      0      0
  5TH +                              *                                5TH        13      6      1      5      0      0      0      0      0      0      0
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      0    10    20    30    40    50    60    70    80    90   100   PROP    (0.63)  0.15   0.02   0.19   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                                      RPBI    (0.23)-0.21  -0.06  -0.06   0.00   0.00   0.00   0.00   0.00   0.00   0.00


ITEM  79     PERCENT OF CORRECT RESPONSE BY FIFTHS                    MATRIX OF RESPONSES BY FIFTHS                    B IS CORRECT RESPONSE

                                                                            A    (B)      C      D      E      F      G      H      I      J   OMIT
  1ST +                                               *               1ST         2     20      0      3      0      0      0      0      0      0      0
  2ND +                                        *                      2ND         6     18      0      2      0      0      0      0      0      0      0
  3RD +                                  *                            3RD         5     14      2      2      0      0      0      0      0      0      1
  4TH +                               *                               4TH         6     13      0      5      0      0      0      0      0      0      0
  5TH +                                   *                           5TH         2     15      2      4      0      0      0      0      0      0      2
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      0    10    20    30    40    50    60    70    80    90   100   PROP      0.17 (0.65) 0.03   0.13   0.00   0.00   0.00   0.00   0.00   0.00   0.02
                                                                      RPBI     -0.01 (0.20)-0.17  -0.09   0.00   0.00   0.00   0.00   0.00   0.00  -0.19


ITEM  80     PERCENT OF CORRECT RESPONSE BY FIFTHS                    MATRIX OF RESPONSES BY FIFTHS                    C IS CORRECT RESPONSE

                                                                            A      B    (C)      D      E      F      G      H      I      J   OMIT
  1ST +                                          *                    1ST         3      2     18      2      0      0      0      0      0      0      0
  2ND +                              *                                2ND         3      2     14      7      0      0      0      0      0      0      0
  3RD +                               *                               3RD         3      2     13      5      0      0      0      0      0      0      1
  4TH +                             *                                 4TH         3      0     12      9      0      0      0      0      0      0      0
  5TH +                         *                                     5TH         6      1     11      6      0      0      0      0      0      0      1
      +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
      0    10    20    30    40    50    60    70    80    90   100   PROP      0.15   0.06 (0.55)  0.23   0.00   0.00   0.00   0.00   0.00   0.00   0.02
                                                                      RPBI     -0.14   0.09 (0.19)-0.13   0.00   0.00   0.00   0.00   0.00   0.00  -0.09
```

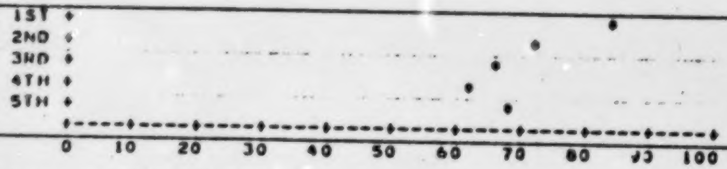
ITEM 81 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS B IS CORRECT RESPONSE

	A	(B)	C	D	E	F	G	H	I	J	OMIT
1ST	[illegible]	23	0	0	0	0	0	0	0	0	0
2ND	4	19	1	2	0	0	0	0	0	0	0
3RD	5	16	0	3	0	0	0	0	0	0	0
4TH	5	17	0	2	0	0	0	0	0	0	0
5TH	7	16	0	2	0	0	0	0	0	0	0
PROP	0.19	(0.73)	0.01	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.19	(0.22)	0.05	-0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00

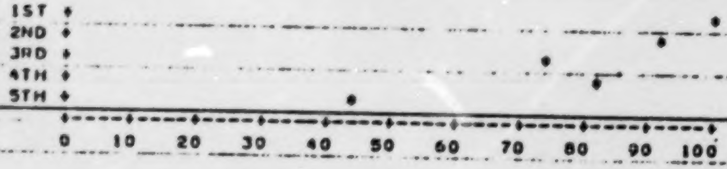
ITEM 82 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS D IS CORRECT RESPONSE

	A	B	C	(D)	E	F	G	H	I	J	OMIT
1ST	0	2	2	21	0	0	0	0	0	0	0
2ND	1	4	2	19	0	0	0	0	0	0	0
3RD	0	4	4	16	0	0	0	0	0	0	0
4TH	0	4	5	15	0	0	0	0	0	0	0
5TH	2	4	2	17	0	0	0	0	0	0	0
PROP	0.02	0.15	0.12	(0.71)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.10	-0.09	-0.03	(0.13)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

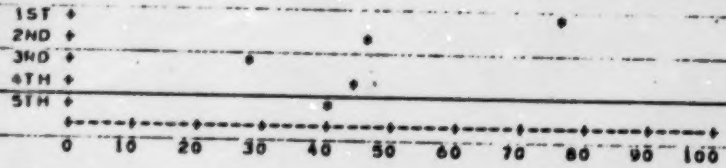
ITEM 83 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS B IS CORRECT RESPONSE

	A	(B)	C	D	E	F	G	H	I	J	OMIT
1ST	0	25	0	0	0	0	0	0	0	0	0
2ND	1	24	1	0	0	0	0	0	0	0	0
3RD	3	18	3	0	0	0	0	0	0	0	0
4TH	1	20	1	2	0	0	0	0	0	0	0
5TH	5	11	4	3	0	0	0	0	0	0	2
PROP	0.08	(0.79)	0.07	0.04	0.10	0.00	0.00	0.00	0.00	0.00	0.02
RPBI	-0.21	(0.44)	-0.19	-0.22	0.10	0.00	0.00	0.00	0.00	0.00	-0.25

ITEM 84 PERCENT OF CORRECT RESPONSE BY FIFTHS

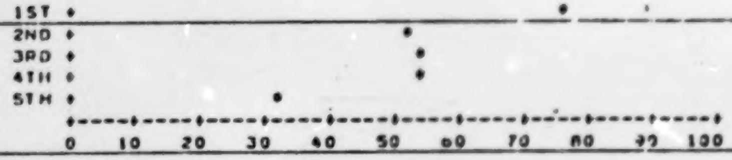


MATRIX OF RESPONSES BY FIFTHS D IS CORRECT RESPONSE

	A	B	C	(D)	E	F	G	H	I	J	OMIT
1ST	2	2	2	19	0	0	0	0	0	0	0
2ND	7	1	6	12	0	0	0	0	0	0	0
3RD	6	0	11	7	0	0	0	0	0	0	0
4TH	8	0	5	11	0	0	0	0	0	0	0
5TH	6	1	8	10	0	0	0	0	0	0	0
PROP	0.23	0.03	0.26	(0.46)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RPBI	-0.08	0.09	-0.19	(0.20)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

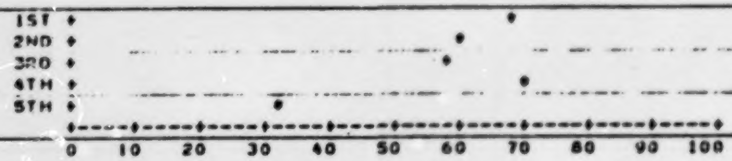
```
  ITEM  85      PERCENT OF CORRECT RESPONSE BY FIFTHS           MATRIX OF RESPONSES BY FIFTHS                      B IS CORRECT RESPONSE

                                                                         A     (B)     C      D      E      F      G      H      I      J   OMIT
    1ST +                                         *             1ST      2     21      0      2      0      0      0      0      0      0      0
    2ND +                                 *                     2ND      4     18      1      3      0      0      0      0      0      0      0
    3RD +                                *                      3RD      4     16      2      2      0      0      0      0      0      0      0
    4TH +                              *                        4TH      8     15      0      1      0      0      0      0      0      0      0
    5TH +                         *                             5TH      3     13      6      3      0      0      0      0      0      0      0
        +----+----+----+----+----+----+----+----+----+----+
        0    10   20   30   40   50   60   70   80   90   100   PROP  0.17  (0.67)  0.07   0.09   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                                RPBI -0.10  (0.24) -0.31   0.01   0.00   0.00   0.00   0.00   0.00   0.00   0.00

  ITEM  86      PERCENT OF CORRECT RESPONSE BY FIFTHS           MATRIX OF RESPONSES BY FIFTHS                      A IS CORRECT RESPONSE

                                                                        (A)     B      C      D      E      F      G      H      I      J   OMIT
    1ST +                               *                       1ST     16      4      5      0      0      0      0      0      0      0      0
    2ND +                    *                                  2ND     11     11      4      0      0      0      0      0      0      0      0
    3RD +               *                                       3RD      8      7      9      0      0      0      0      0      0      0      0
    4TH +                        *                              4TH     12      7      4      1      0      0      0      0      0      0      0
    5TH +                   *                                   5TH     10     10      3      1      0      0      0      0      0      0      1
        +----+----+----+----+----+----+----+----+----+----+
        0    10   20   30   40   50   60   70   80   90   100   PROP (0.46)  0.31   0.20   0.02   0.00   0.00   0.00   0.00   0.00   0.00   0.01
                                                                RPBI (0.12) -0.10   0.03  -0.13   0.00   0.00   0.00   0.00   0.00   0.00  -0.11

  ITEM  87      PERCENT OF CORRECT RESPONSE BY FIFTHS           MATRIX OF RESPONSES BY FIFTHS                      B IS CORRECT RESPONSE

                                                                         A     (B)     C      D      E      F      G      H      I      J   OMIT
    1ST +                                   *                   1ST      1     18      2      4      0      0      0      0      0      0      0
    2ND +                             *                         2ND      3     16      2      5      0      0      0      0      0      0      0
    3RD +                 *                                     3RD      2      9      7      5      0      0      0      0      0      0      1
    4TH +         *                                             4TH      6      5     10      2      0      0      0      0      0      0      1
    5TH +             *                                         5TH      2      7      9      6      0      0      0      0      0      0      1
        +----+----+----+----+----+----+----+----+----+----+
        0    10   20   30   40   50   60   70   80   90   100   PROP  0.11  (0.44)  0.24   0.18   0.00   0.00   0.00   0.00   0.00   0.00   0.02
                                                                RPBI -0.10  (0.38) -0.30  -0.03   0.00   0.00   0.00   0.00   0.00   0.00  -0.12

  ITEM  88      PERCENT OF CORRECT RESPONSE BY FIFTHS           MATRIX OF RESPONSES BY FIFTHS                      A IS CORRECT RESPONSE

                                                                        (A)     B      C      D      E      F      G      H      I      J   OMIT
    1ST +                                             *         1ST     23      0      1      1      0      0      0      0      0      0      0
    2ND +                                         *             2ND     22      0      4      0      0      0      0      0      0      0      0
    3RD +                                      *                3RD     19      2      2      1      0      0      0      0      0      0      0
    4TH +                              *                        4TH     15      3      4      2      0      0      0      0      0      0      0
    5TH +                       *                               5TH     12      3      4      5      0      0      0      0      0      0      1
        +----+----+----+----+----+----+----+----+----+----+
        0    10   20   30   40   50   60   70   80   90   100   PROP (0.73)  0.06   0.12   0.07   0.00   0.00   0.00   0.00   0.00   0.00   0.01
                                                                RPBI (0.36) -0.22  -0.08  -0.24   0.00   0.00   0.00   0.00   0.00   0.00  -0.20
```

ITEM 89 PERCENT OF CORRECT RESPONSE BY FIFTHS



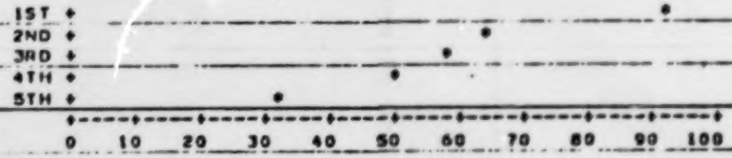
```
MATRIX OF RESPONSES BY FIFTHS                    D IS CORRECT RESPONSE

          A      B      C     (D)     E      F      G      H      I      J   OMIT
1ST       4      0      2     19      0      0      0      0      0      0      0
2ND       6      2      2     14      0      0      0      0      0      0      1
3RD       6      2      2     13      0      0      0      0      0      0      1
4TH       5      5      1     13      0      0      0      0      0      0      0
5TH       7      3      6      8      0      0      0      0      0      0      1

PROP   0.23   0.10   0.11 (0.54)  0.00   0.00   0.00   0.00   0.00   0.00   0.02
RPBI  -0.10  -0.17  -0.13 (0.28)  0.00   0.00   0.00   0.00   0.00   0.00  -0.05
```

ITEM 90 PERCENT OF CORRECT RESPONSE BY FIFTHS



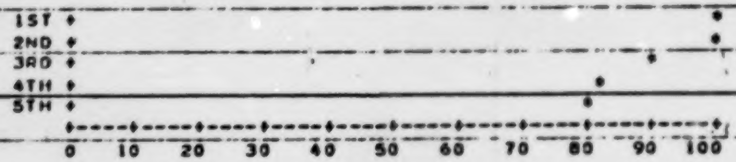
```
MATRIX OF RESPONSES BY FIFTHS                    C IS CORRECT RESPONSE

          A      B     (C)     D      E      F      G      H      I      J   OMIT
1ST       6      1     17      1      0      0      0      0      0      0      0
2ND       5      5     16      0      0      0      0      0      0      0      0
3RD       6      1     14      2      0      0      0      0      0      0      1
4TH       7      0     17      0      0      0      0      0      0      0      0
5TH      10      6      8      1      0      0      0      0      0      0      0

PROP   0.27   0.10 (0.58)  0.03   0.00   0.00   0.00   0.00   0.00   0.00   0.01
RPBI  -0.13  -0.08 (0.17)  0.00   0.00   0.00   0.00   0.00   0.00   0.00  -0.01
```

ITEM 91 PERCENT OF CORRECT RESPONSE BY FIFTHS



```
MATRIX OF RESPONSES BY FIFTHS                    B IS CORRECT RESPONSE

          A     (B)     C      D      E      F      G      H      I      J   OMIT
1ST       1     23      1      0      0      0      0      0      0      0      0
2ND       5     17      4      0      0      0      0      0      0      0      0
3RD       6     14      3      0      0      0      0      0      0      0      1
4TH       7     12      5      0      0      0      0      0      0      0      0
5TH      11      8      5      1      0      0      0      0      0      0      0

PROP   0.24 (0.60)  0.15   0.01   0.00   0.00   0.00   0.00   0.00   0.00   0.01
RPBI  -0.27 (0.40)-0.19  -0.15   0.00   0.00   0.00   0.00   0.00   0.00   0.03
```

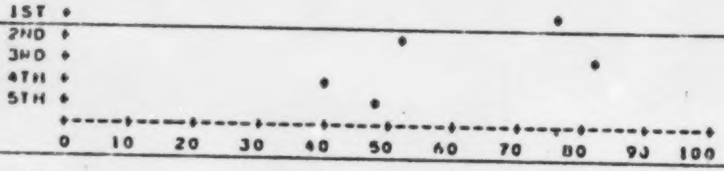
ITEM 92 PERCENT OF CORRECT RESPONSE BY FIFTHS



```
MATRIX OF RESPONSES BY FIFTHS                    C IS CORRECT RESPONSE

          A      B     (C)     D      E      F      G      H      I      J   OMIT
1ST       0      0     25      0      0      0      0      0      0      0      0
2ND       0      0     26      0      0      0      0      0      0      0      0
3RD       1      1     22      0      0      0      0      0      0      0      0
4TH       3      0     20      1      0      0      0      0      0      0      0
5TH       1      2     20      2      0      0      0      0      0      0      0

PROP   0.04   0.02 (0.91)  0.02   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI  -0.10  -0.17 (0.29)-0.24   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

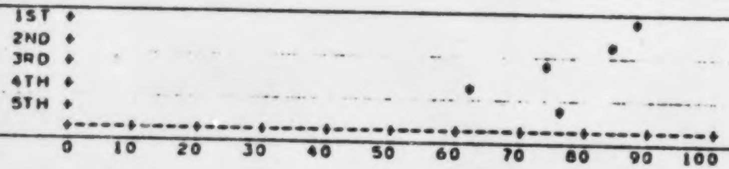
```
ITEM  93     PERCENT OF CORRECT RESPONSE BY FIFTHS        MATRIX OF RESPONSES BY FIFTHS                 B IS CORRECT RESPONSE

      1ST +                                            *              A   (B)    C     D     E     F     G     H     I     J  OMIT
      2ND +                                      *        1ST         2   22     1     0     0     0     0     0     0     0     0
      3RD +                       *                       2ND         5   20     1     0     0     0     0     0     0     0     0
      4TH +                             *                 3RD        10   11     3     0     0     0     0     0     0     0     0
      5TH +                        *                      4TH         6   14     3     1     0     0     0     0     0     0     0
          +----+----+----+----+----+----+----+----+----+----+  5TH         9   12     2     2     0     0     0     0     0     0     0
          0    10   20   30   40   50   60   70   80   90   100
                                                          PROP    0.26 (0.64) 0.08  0.02  0.00  0.00  0.00  0.00  0.00  0.00  0.00
                                                          RPBI   -0.22 (0.28)-0.06 -0.15  0.00  0.00  0.00  0.00  0.00  0.00  0.00

ITEM  94     PERCENT OF CORRECT RESPONSE BY FIFTHS        MATRIX OF RESPONSES BY FIFTHS                 C IS CORRECT RESPONSE

      1ST +                        *                                  A     B   (C)    D     E     F     G     H     I     J  OMIT
      2ND +                 *                             1ST         3     2    12    6     0     0     0     0     0     0     0
      3RD +              *                                2ND         2     5     9   10     0     0     0     0     0     0     0
      4TH +              *                                3RD         4     4     7    9     0     0     0     0     0     0     0
      5TH +                  *                            4TH         3     5     7    6     0     0     0     0     0     0     0
          +----+----+----+----+----+----+----+----+----+----+  5TH         6     4     9    5     0     0     0     0     0     0     1
          0    10   20   30   40   50   60   70   80   90   100
                                                          PROP    0.15  0.16 (0.35) 0.33  0.00  0.00  0.00  0.00  0.00  0.00  0.01
                                                          RPBI   -0.14 -0.03 (0.10) 0.06  0.00  0.00  0.00  0.00  0.00  0.00 -0.20

ITEM  95     PERCENT OF CORRECT RESPONSE BY FIFTHS        MATRIX OF RESPONSES BY FIFTHS                 C IS CORRECT RESPONSE

      1ST +                                        *                  A     B   (C)    D     E     F     G     H     I     J  OMIT
      2ND +                                  *            1ST         2     1    20    2     0     0     0     0     0     0     0
      3RD +                                     *         2ND         4     1    18    2     1     0     0     0     0     0     0
      4TH +                                 *             3RD         2     1    18    2     0     0     0     0     0     0     1
      5TH +                                        *      4TH         3     2    16    3     0     0     0     0     0     0     0
          +----+----+----+----+----+----+----+----+----+----+  5TH         1     3    20    1     0     0     0     0     0     0     0
          0    10   20   30   40   50   60   70   80   90   100
                                                          PROP    0.10  0.06 (0.74) 0.08  0.01  0.00  0.00  0.00  0.00  0.00  0.01
                                                          RPBI    0.07 -0.13 (0.00) 0.01  0.08  0.00  0.00  0.00  0.00  0.00  0.03

ITEM  96     PERCENT OF CORRECT RESPONSE BY FIFTHS        MATRIX OF RESPONSES BY FIFTHS                 D IS CORRECT RESPONSE

      1ST +                                  *                        A     B     C   (D)    E     F     G     H     I     J  OMIT
      2ND +                                *              1ST         2     2     4   17     0     0     0     0     0     0     0
      3RD +                                         *     2ND         1     0     7   17     1     0     0     0     0     0     0
      4TH +                                 *             3RD         1     1     2   20     0     0     0     0     0     0     0
      5TH +                                  *            4TH         0     0     8   16     0     0     0     0     0     0     0
          +----+----+----+----+----+----+----+----+----+----+  5TH         2     0     6   17     0     0     0     0     0     0     0
          0    10   20   30   40   50   60   70   80   90   100
                                                          PROP    0.05  0.02  0.22 (0.70) 0.01  0.00  0.00  0.00  0.00  0.00  0.00
                                                          RPBI    0.01  0.13 -0.10 (0.03) 0.08  0.00  0.00  0.00  0.00  0.00  0.00
```

ITEM 97   PERCENT OF CORRECT RESPONSE BY FIFTHS



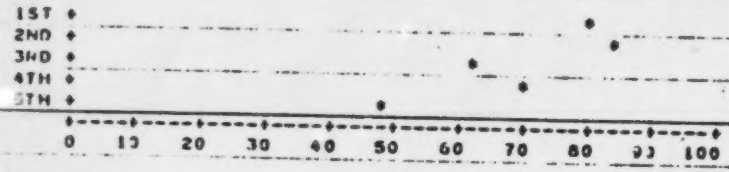
```
MATRIX OF RESPONSES BY FIFTHS                          C IS CORRECT RESPONSE

            A      B     (C)     D      E      F      G      H      I      J   OMIT
 1ST        0      3     19      3      0      0      0      0      0      0      0
 2ND        1      5     14      6      0      0      0      0      0      0      0
 3RD        1      2     20      1      0      0      0      0      0      0      0
 4TH        6      2     10      6      0      0      0      0      0      0      0
 5TH        2      2     12      9      0      0      0      0      0      0      0

PROP     0.08   0.11 (0.60) 0.20   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI    -0.16   0.07 (0.23)-0.22   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 98   PERCENT OF CORRECT RESPONSE BY FIFTHS



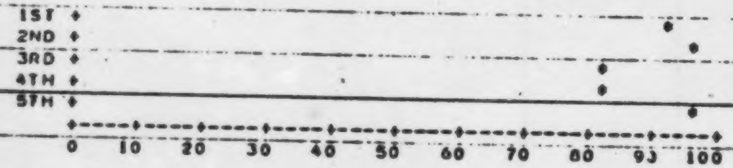
```
MATRIX OF RESPONSES BY FIFTHS                          B IS CORRECT RESPONSE

            A     (B)     C      D      E      F      G      H      I      J   OMIT
 1ST        3     22      0      0      0      0      0      0      0      0      0
 2ND        4     22      0      0      0      0      0      0      0      0      0
 3RD        5     18      1      0      0      0      0      0      0      0      0
 4TH        7     15      1      1      0      0      0      0      0      0      0
 5TH        4     19      2      0      0      0      0      0      0      0      0

PROP     0.19 (0.77) 0.03   0.01   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI    -0.10 (0.16)-0.13  -0.08   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 99   PERCENT OF CORRECT RESPONSE BY FIFTHS



```
MATRIX OF RESPONSES BY FIFTHS                          B IS CORRECT RESPONSE

            A     (B)     C      D      E      F      G      H      I      J   OMIT
 1ST        1     20      4      0      0      0      0      0      0      0      0
 2ND        1     22      3      0      0      0      0      0      0      0      0
 3RD        1     15      7      1      0      0      0      0      0      0      0
 4TH        3     17      2      2      0      0      0      0      0      0      0
 5TH        4     12      5      1      0      0      0      0      0      0      3

PROP     0.08 (0.69) 0.17   0.03   0.00   0.00   0.00   0.00   0.00   0.00   0.02
RPBI    -0.19 (0.25) 0.02  -0.12   0.00   0.00   0.00   0.00   0.00   0.00  -0.32
```

ITEM 100   PERCENT OF CORRECT RESPONSE BY FIFTHS



```
MATRIX OF RESPONSES BY FIFTHS                          B IS CORRECT RESPONSE

            A     (B)     C      D      E      F      G      H      I      J   OMIT
 1ST        0     23      0      2      0      0      0      0      0      0      0
 2ND        0     25      0      1      0      0      0      0      0      0      0
 3RD        0     20      0      4      0      0      0      0      0      0      0
 4TH        0     20      0      4      0      0      0      0      0      0      0
 5TH        0     24      0      1      0      0      0      0      0      0      0

PROP     0.00 (0.90) 0.00   0.10   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI     0.00 (0.01) 0.00   0.01   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

```
ITEM 101      PERCENT OF CORRECT RESPONSE BY FIFTHS           MATRIX OF RESPONSES BY FIFTHS                       B IS CORRECT RESPONSE

                                                                          A    (B)      C      D      E      F      G      H      I      J   OMIT
    1ST +                                 *                   1ST       0     17      2      6      0      0      0      0      0      0      0
    2ND +                                       *             2ND       2     21      0      3      0      0      0      0      0      0      0
    3RD +                                *                    3RD       0     16      2      4      0      0      0      0      0      0      2
    4TH +                            *                        4TH       5     14      0      5      0      0      0      0      0      0      0
    5TH +                     *                               5TH       5     11      2      7      0      0      0      0      0      0      0
        +----+----+----+----+----+----+----+----+----+----+
        0    10   20   30   40   50   60   70   80   90  100  PROP   0.10 (0.64)   0.05   0.20   0.00   0.00   0.00   0.00   0.00   0.00   0.02
                                                              RPBI  -0.25 (0.18)   0.02  -0.05   0.00   0.00   0.00   0.00   0.00   0.00   0.03

ITEM 102      PERCENT OF CORRECT RESPONSE BY FIFTHS           MATRIX OF RESPONSES BY FIFTHS                       A IS CORRECT RESPONSE

                                                                        (A)      B      C      D      E      F      G      H      I      J   OMIT
    1ST +                                               *     1ST      24      0      0      1      0      0      0      0      0      0      0
    2ND +                                             *       2ND      24      0      0      2      0      0      0      0      0      0      0
    3RD +                                    *                3RD      18      0      0      6      0      0      0      0      0      0      0
    4TH +                                  *                  4TH      17      1      1      5      0      0      0      0      0      0      0
    5TH +                       *                             5TH      12      1     10      2      0      0      0      0      0      0      0
        +----+----+----+----+----+----+----+----+----+----+
        0    10   20   30   40   50   60   70   80   90  100  PROP (0.77)   0.02   0.09   0.13   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                              RPBI (0.42)  -0.13  -0.43  -0.11   0.00   0.00   0.00   0.00   0.00   0.00   0.00

ITEM 103      PERCENT OF CORRECT RESPONSE BY FIFTHS           MATRIX OF RESPONSES BY FIFTHS                       C IS CORRECT RESPONSE

                                                                          A      B    (C)      D      E      F      G      H      I      J   OMIT
    1ST +                                             *       1ST       1      1     23      0      0      0      0      0      0      0      0
    2ND +                           *                         2ND       2      4     15      5      0      0      0      0      0      0      0
    3RD +                        *                            3RD       2      4     12      5      0      0      0      0      0      0      1
    4TH +                            *                        4TH       2      5     14      3      0      0      0      0      0      0      0
    5TH +                     *                               5TH       2      7     11      5      0      0      0      0      0      0      0
        +----+----+----+----+----+----+----+----+----+----+
        0    10   20   30   40   50   60   70   80   90  100  PROP   0.07   0.17 (0.60)   0.15   0.00   0.00   0.00   0.00   0.00   0.00   0.01
                                                              RPBI  -0.02  -0.19 (0.25)  -0.13   0.00   0.00   0.00   0.00   0.00   0.00   0.02

ITEM 104      PERCENT OF CORRECT RESPONSE BY FIFTHS           MATRIX OF RESPONSES BY FIFTHS                       D IS CORRECT RESPONSE

                                                                          A      B      C    (D)      E      F      G      H      I      J   OMIT
    1ST +                                           *         1ST       3      0      0     22      0      0      0      0      0      0      0
    2ND +                           *                         2ND       8      1      2     15      0      0      0      0      0      0      0
    3RD +                                *                    3RD       4      2      1     16      0      0      0      0      0      0      1
    4TH +                                  *                  4TH       6      1      0     17      0      0      0      0      0      0      0
    5TH +                   *                                 5TH      10      2      3     10      0      0      0      0      0      0      0
        +----+----+----+----+----+----+----+----+----+----+
        0    10   20   30   40   50   60   70   80   90  100  PROP   0.25   0.05   0.05 (0.65)   0.00   0.00   0.00   0.00   0.00   0.00   0.01
                                                              RPBI  -0.21  -0.13  -0.11 (0.29)   0.00   0.00   0.00   0.00   0.00   0.00   0.03
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MAY 21, 1981            * * *   MERMAC -- TEST ANALYSIS AND QUESTIONNAIRE PACKAGE   * * *                174

ITEM 105    PERCENT OF CORRECT RESPONSE BY FIFTHS           MATRIX OF RESPONSES BY FIFTHS              D IS CORRECT RESPONSE

                                                                  A      B      C    (D)      E      F      G      H      I      J   OMIT
  1ST +                               *                     1ST       7      2      0     16      0      0      0      0      0      0      0
  2ND +                      *                              2ND       7      5      2     12      0      0      0      0      0      0      0
  3RD +                          *                          3RD       4      7      0     13      0      0      0      0      0      0      0
  4TH +               *                                     4TH       3     11      2      8      0      0      0      0      0      0      0
  5TH +                 *                                   5TH       3      9      4      9      0      0      0      0      0      0      0
      +----+----+----+----+----+----+----+----+----+----+
      0    10   20   30   40   50   60   70   80   90   100 PROP   0.19   0.27   0.06 (0.47)   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                            RPBI   0.17  -0.26  -0.23 (0.22)   0.00   0.00   0.00   0.00   0.00   0.00   0.00

ITEM 106    PERCENT OF CORRECT RESPONSE BY FIFTHS           MATRIX OF RESPONSES BY FIFTHS              C IS CORRECT RESPONSE

                                                                  A      B    (C)      D      E      F      G      H      I      J   OMIT
  1ST +                             *                       1ST       2      5     15      3      0      0      0      0      0      0      0
  2ND +                    *                                2ND       0     10     11      5      0      0      0      0      0      0      0
  3RD +             *                                       3RD       1     13      7      3      0      0      0      0      0      0      0
  4TH +   *                                                 4TH       0     18      2      4      0      0      0      0      0      0      0
  5TH +                                                     5TH       0     16      0      9      0      0      0      0      0      0      0
      +----+----+----+----+----+----+----+----+----+----+
      0    10   20   30   40   50   60   70   80   90   100 PROP   0.02   0.50 (0.28)   0.19   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                            RPBI   0.11  -0.31 (0.47)  -0.19   0.00   0.00   0.00   0.00   0.00   0.00   0.00

ITEM 107    PERCENT OF CORRECT RESPONSE BY FIFTHS           MATRIX OF RESPONSES BY FIFTHS              C IS CORRECT RESPONSE

                                                                  A      B    (C)      D      E      F      G      H      I      J   OMIT
  1ST +                             *                       1ST       0      1     15      9      0      0      0      0      0      0      0
  2ND +            *                                        2ND       1      1      7     17      0      0      0      0      0      0      0
  3RD +                 *                                   3RD       0      0      9     15      0      0      0      0      0      0      0
  4TH +           *                                         4TH       0      0      6     18      0      0      0      0      0      0      0
  5TH +       *                                             5TH       2      1      4     18      0      0      0      0      0      0      0
      +----+----+----+----+----+----+----+----+----+----+
      0    10   20   30   40   50   60   70   80   90   100 PROP   0.02   0.02 (0.33)   0.62   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                            RPBI  -0.10   0.02 (0.27)  -0.23   0.00   0.00   0.00   0.00   0.00   0.00   0.00

ITEM 108    PERCENT OF CORRECT RESPONSE BY FIFTHS           MATRIX OF RESPONSES BY FIFTHS              D IS CORRECT RESPONSE

                                                                  A      B      C    (D)      E      F      G      H      I      J   OMIT
  1ST +                   *                                 1ST       2     11      2     10      0      0      0      0      0      0      0
  2ND +          *                                          2ND       2      9      9      6      0      0      0      0      0      0      0
  3RD +                   *                                 3RD       1      8      4     10      0      0      0      0      0      0      1
  4TH +       *                                             4TH       3      9      8      4      0      0      0      0      0      0      0
  5TH +                                                     5TH       4      8     12      0      0      0      0      0      0      0      1
      +----+----+----+----+----+----+----+----+----+----+
      0    10   20   30   40   50   60   70   80   90   100 PROP   0.10   0.36   0.28 (0.24)   0.00   0.00   0.00   0.00   0.00   0.00   0.02
                                                            RPBI  -0.06   0.05  -0.27 (0.30)   0.00   0.00   0.00   0.00   0.00   0.00  -0.12
```

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ITEM 109       PERCENT OF CORRECT RESPONSE BY FIFTHS             MATRIX OF RESPONSES BY FIFTHS                      A IS CORRECT RESPONSE

                                                                      (A)      B      C      D      E      F      G      H      I      J   OMIT
  1ST +                             *                         1ST      15      9      1      0      0      0      0      0      0      0      0
  2ND +                                 *                     2ND      18      6      1      1      0      0      0      0      0      0      0
  3RD +                            *                          3RD      14      8      1      0      0      0      0      0      0      0      1
  4TH +                     *                                 4TH      11      9      3      1      0      0      0      0      0      0      0
  5TH +           *                                           5TH       6      9      4      0      0      0      0      0      0      0      0
      +----+----+----+----+----+----+----+----+----+----+
      0    10   20   30   40   50   60   70   80   90   100     PROP  (0.52)   0.33   0.08   0.06   0.00   0.00   0.00   0.00   0.00   0.00   0.01
                                                              RPBI  (0.28)  -0.07  -0.17  -0.26   0.00   0.00   0.00   0.00   0.00   0.00   0.03

ITEM 110       PERCENT OF CORRECT RESPONSE BY FIFTHS             MATRIX OF RESPONSES BY FIFTHS                      D IS CORRECT RESPONSE

                                                                        A      B      C    (D)      E      F      G      H      I      J   OMIT
  1ST +                 *                                     1ST       3      4      9      9      0      0      0      0      0      0      0
  2ND +                           *                           2ND       2      0      9     15      0      0      0      0      0      0      0
  3RD +                            *                          3RD       3      1      6     14      0      0      0      0      0      0      0
  4TH +             *                                         4TH       6      1     10      7      0      0      0      0      0      0      0
  5TH +                     *                                 5TH       4      1      9     11      0      0      0      0      0      0      0
      +----+----+----+----+----+----+----+----+----+----+
      0    10   20   30   40   50   60   70   80   90   100     PROP    0.15   0.06   0.35 (0.45)   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                              RPBI   -0.13   0.11  -0.01 (0.05)   0.00   0.00   0.00   0.00   0.00   0.00   0.00

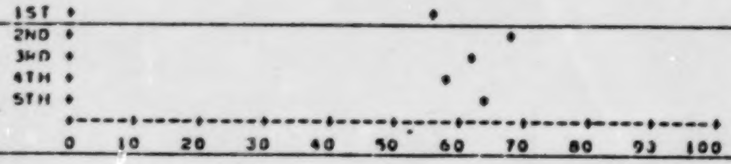
ITEM 111       PERCENT OF CORRECT RESPONSE BY FIFTHS             MATRIX OF RESPONSES BY FIFTHS                      B IS CORRECT RESPONSE

                                                                        A    (B)      C      D      E      F      G      H      I      J   OMIT
  1ST +                                           *           1ST       1     22      0      2      0      0      0      0      0      0      0
  2ND +                                           *           2ND       0     23      0      3      0      0      0      0      0      0      0
  3RD +                                          *            3RD       0     21      1      2      0      0      0      0      0      0      0
  4TH +                                              *        4TH       0     23      0      1      0      0      0      0      0      0      0
  5TH +                                           *           5TH       1     22      1      1      0      0      0      0      0      0      0
      +----+----+----+----+----+----+----+----+----+----+
      0    10   20   30   40   50   60   70   80   90   100     PROP    0.02 (0.90)   0.02   0.07   0.00   0.00   0.00   0.00   0.00   0.00   0.00
                                                              RPBI   -0.00 (0.02)  -0.11   0.03   0.00   0.00   0.00   0.00   0.00   0.00   0.00

ITEM 112       PERCENT OF CORRECT RESPONSE BY FIFTHS             MATRIX OF RESPONSES BY FIFTHS                      B IS CORRECT RESPONSE

                                                                        A    (B)      C      D      E      F      G      H      I      J   OMIT
  1ST +                                               *       1ST       1     24      0      0      0      0      0      0      0      0      0
  2ND +                                           *           2ND       3     23      0      0      0      0      0      0      0      0      0
  3RD +                                      *                3RD       4     19      1      0      0      0      0      0      0      0      0
  4TH +                                        *              4TH       1     20      0      2      0      0      0      0      0      0      1
  5TH +                                     *                 5TH       3     19      2      1      0      0      0      0      0      0      0
      +----+----+----+----+----+----+----+----+----+----+
      0    10   20   30   40   50   60   70   80   90   100     PROP    0.10 (0.85)   0.02   0.02   0.00   0.00   0.00   0.00   0.00   0.00   0.01
                                                              RPBI   -0.06 (0.18)  -0.12  -0.15   0.00   0.00   0.00   0.00   0.00   0.00  -0.06
```

ITEM 113 PERCENT OF CORRECT RESPONSE BY FIFTHS

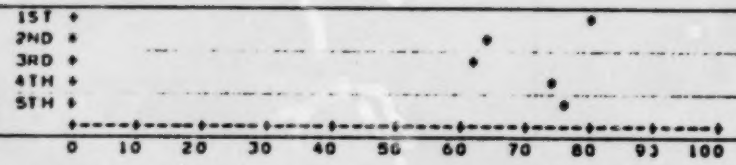


```
MATRIX OF RESPONSES BY FIFTHS                     A IS CORRECT RESPONSE

         (A)     B      C      D      E      F      G      H      I      J   OMIT
1ST      14      6      4      1      0      0      0      0      0      0      0
2ND      18      5      3      0      0      0      0      0      0      0      0
3RD      15      4      5      0      0      0      0      0      0      0      0
4TH      14      6      3      1      0      0      0      0      0      0      0
5TH      16      5      4      0      0      0      0      0      0      0      0

PROP  (0.62)  0.21   0.15   0.02   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI  (0.02) -0.03   0.00   0.03   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 114 PERCENT OF CORRECT RESPONSE BY FIFTHS

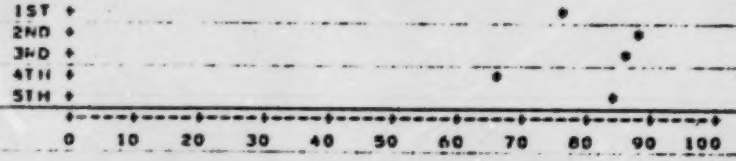


```
MATRIX OF RESPONSES BY FIFTHS                     C IS CORRECT RESPONSE

          A      B     (C)     D      E      F      G      H      I      J   OMIT
1ST       0      4     20      1      0      0      0      0      0      0      0
2ND       3      3     17      3      0      0      0      0      0      0      0
3RD       0      4     15      4      0      0      0      0      0      0      1
4TH       1      2     18      3      0      0      0      0      0      0      0
5TH       1      1     19      4      0      0      0      0      0      0      0

PROP    0.04   0.11  (0.72)  0.12   0.00   0.00   0.00   0.00   0.00   0.00   0.01
RPBI   -0.02   0.10  (0.01) -0.12   0.00   0.00   0.00   0.00   0.00   0.00   0.03
```

ITEM 115 PERCENT OF CORRECT RESPONSE BY FIFTHS

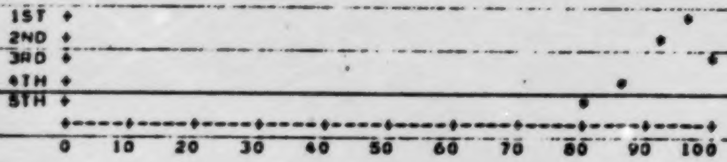


```
MATRIX OF RESPONSES BY FIFTHS                     B IS CORRECT RESPONSE

          A     (B)     C      D      E      F      G      H      I      J   OMIT
1ST       1     19      5      0      0      0      0      0      0      0      0
2ND       0     23      3      0      0      0      0      0      0      0      0
3RD       0     21      3      0      0      0      0      0      0      0      0
4TH       1     16      6      1      0      0      0      0      0      0      0
5TH       0     21      3      1      0      0      0      0      0      0      0

PROP    0.02  (0.81)  0.16   0.02   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI    0.03  (0.02)  0.01  -0.12   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

ITEM 116 PERCENT OF CORRECT RESPONSE BY FIFTHS

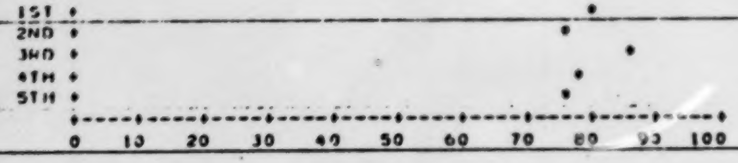


```
MATRIX OF RESPONSES BY FIFTHS                     A IS CORRECT RESPONSE

         (A)     B      C      D      E      F      G      H      I      J   OMIT
1ST      24      0      1      0      0      0      0      0      0      0      0
2ND      24      0      1      0      0      0      0      0      0      0      1
3RD      24      0      0      0      0      0      0      0      0      0      0
4TH      21      1      2      0      0      0      0      0      0      0      0
5TH      20      1      2      2      0      0      0      0      0      0      0

PROP  (0.91)  0.02   0.05   0.02   0.00   0.00   0.00   0.00   0.00   0.00   0.01
RPBI  (0.22) -0.19  -0.10  -0.21   0.00   0.00   0.00   0.00   0.00   0.00   0.09
```

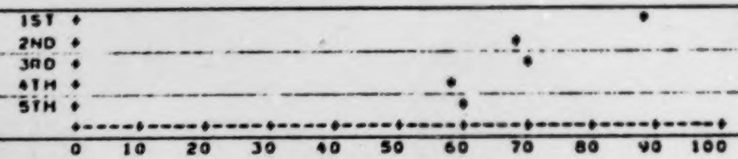
ITEM 117 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS D IS CORRECT RESPONSE

	A	B	C	(D)	E	F	G	H	I	J	OMIT
1ST	0	0	4	20	0	0	0	0	0	0	1
2ND	3	1	2	20	0	0	0	0	0	0	0
3RD	2	0	1	21	0	0	0	0	0	0	0
4TH	1	0	4	19	0	0	0	0	0	0	0
5TH	1	0	5	19	0	0	0	0	0	0	0
PROP	0.06	0.01	0.13	(0.80)	0.00	0.00	0.00	0.00	0.00	0.00	0.01
RPBI	-0.03	0.05	-0.07	(0.04)	0.00	0.00	0.00	0.00	0.00	0.00	0.12

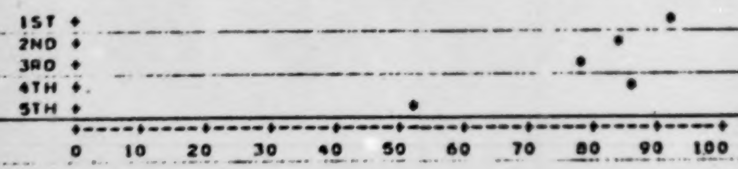
ITEM 118 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS A IS CORRECT RESPONSE

	(A)	B	C	D	E	F	G	H	I	J	OMIT
1ST	22	0	1	1	0	0	0	0	0	0	1
2ND	18	1	6	1	0	0	0	0	0	0	0
3RD	17	1	3	2	0	0	0	0	0	0	1
4TH	14	0	9	1	0	0	0	0	0	0	0
5TH	15	1	9	0	0	0	0	0	0	0	0
PROP	(0.69)	0.02	0.23	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.02
RPBI	(0.21)	-0.02	-0.28	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.11

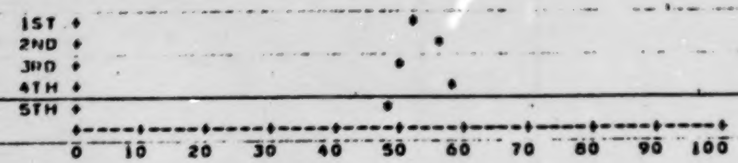
ITEM 119 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS C IS CORRECT RESPONSE

	A	B	(C)	D	E	F	G	H	I	J	OMIT
1ST	1	0	23	0	0	0	0	0	0	0	1
2ND	4	0	22	0	0	0	0	0	0	0	0
3RD	4	1	19	0	0	0	0	0	0	0	0
4TH	3	0	21	0	0	0	0	0	0	0	0
5TH	12	0	13	0	0	0	0	0	0	0	0
PROP	0.19	0.01	(0.79)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
RPBI	-0.31	0.02	(0.27)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12

ITEM 120 PERCENT OF CORRECT RESPONSE BY FIFTHS



MATRIX OF RESPONSES BY FIFTHS D IS CORRECT RESPONSE

	A	B	C	(D)	E	F	G	H	I	J	OMIT
1ST	7	0	4	13	0	0	0	0	0	0	1
2ND	5	3	3	15	0	0	0	0	0	0	0
3RD	5	3	3	12	0	0	0	0	0	0	1
4TH	2	5	3	14	0	0	0	0	0	0	0
5TH	4	6	3	12	0	0	0	0	0	0	0
PROP	0.19	0.14	0.13	(0.53)	0.00	0.00	0.00	0.00	0.00	0.00	0.02
RPBI	0.10	-0.19	-0.03	(0.05)	0.00	0.00	0.00	0.00	0.00	0.00	0.11

F2

CONSULTANTS REPORT

PROFICIENCY/EQUIVALENCY TESTING IN CLINICAL LABORATORY SCIENCES

This report summarizes approximately three days of consulting for the Medical Laboratory Technology Project. Included in the three days were a meeting in May of 1980 with Ms. Dietrich to review the item analysis printout used to analyze the questions used in the first phase of the trial testing and to plan for the workshop with the entire committee. The item analysis used in the first test was in a format that revealed the mean test score for the candidates that selected each option including the answer. I reviewed all the test statistics and identified questions that were either statistically ambiguous and/or incorrectly keyed. This enabled the committee at the meeting to concentrate on rewriting or correcting items that were not functioning. Included in the item analysis printout was the difficulty level of each question, i.e., the precentage of candidates answering the question correctly and the correlation between those answering the question and their total test score. An example of a similar printout is included in Appendix A.

Prior to discussing the statistical aspect of the test at the committee meeting, a discussion of what my interpretation of a criterion referenced test was and how this contrasted with a norm referenced test. Briefly a criterion referenced test relates to the aspects of tasks that are relevant to the work to be performed. In other words, is it job-related? Also in a criterion referenced test we are only interested in two groups; those who will be judged competent and those who will be judged incompetent. In a norm referenced test the goal is to spread out people so that you make judgments or statements about individuals. A test question that distinguished the top ten percent of the competent individuals from the ninety percent is good for norm-referenced test but is ineffectual for most criterion referenced tests.

After this discussion, the groups spent the rest of the day rewriting and reworking the questions. Subsequent to this meeting, two tests had been developed and administered.

During June of 1981 the second analysis was mailed to me for my reaction. The specific comments are included in Appendix B. A constraint that should be observed in reviewing my comments is the limitation of the size of the sample. A larger sample might provide sufficient additional data that could offset random kind of errors. It should also be noted that questions could be good statistically but deficient, or poor statistically and very acceptable for a content goodness point of view. In other words, an item covering new content may not be known to the general population and consequently may have questionable statistics due to the fact that it is not universally taught.

FINAL TEST ANALYSIS

The final test analysis differed in format than the first format.

The first part of the analysis (A) illustrates the percentage correct by fifths based on the scores in the total test. (Insert 1 page 3) Questions with characteristics of item 21 would be good for separating the top three fifths from the lower two fifths as their performance is 30 percentage points apart, 45 for lower fourth and the 75 for third fifth. If a test was made up of questions all like number 24 and the flunk rate was 20%, the lower fifth would do better than the next higher fifth. Consequently, you could have problems. Again, remember that you are working with small numbers.

The second part of the analysis (Insert 2 page 4) is different than the analysis used in the first round in that instead of raw scores means of those selecting each option you have a correlation of the scores of those who selected the option with total test score. Ideally, the answer should have a positive correlation (RPI) and the wrong answers, in the main, negative. Take questions 21, .65 (PROP) percent selected the correct answer and the (RPI) is 0.34. Good. Only 14% selected A -0.03; 13% B-0.14; and 7% D -0.34. EFGHIJ have no meaning and are artifacts of this program.

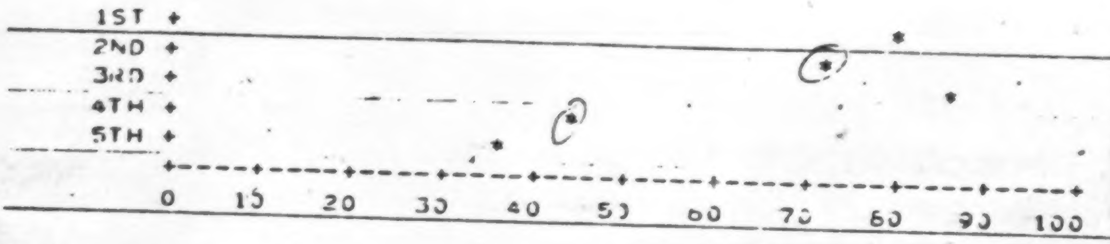
Question number 24 has problems worth looking at in that 40% selected B (only 47% picked the answer C) and the RPBI are not too different (0.05 vs. 0.10).

I have identified a few items on each test that I think should be examined. (Appendix B)

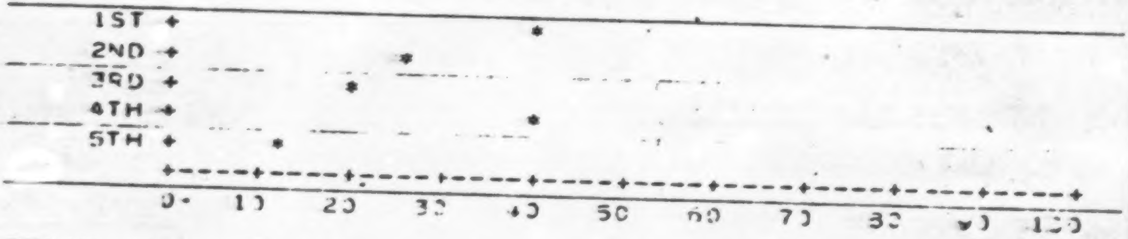
In conclusion, I feel that these are good tests from a statistical point of view with good reliabilities and a very conscientious job was done in revising the examinations.

William Kastrinos
Director, Test Development

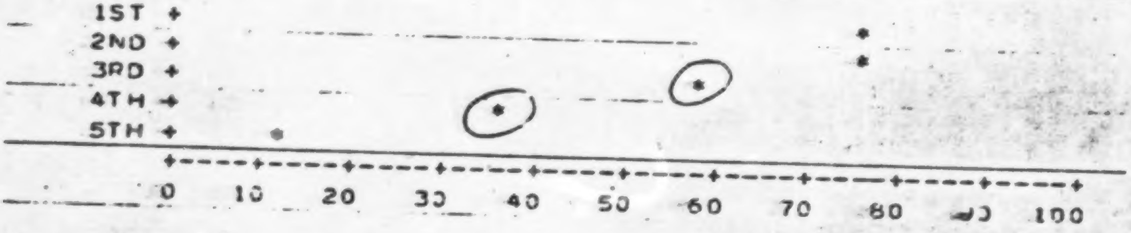
ITEM 21 PERCENT OF CORRECT RESPONSE BY FIFTHS



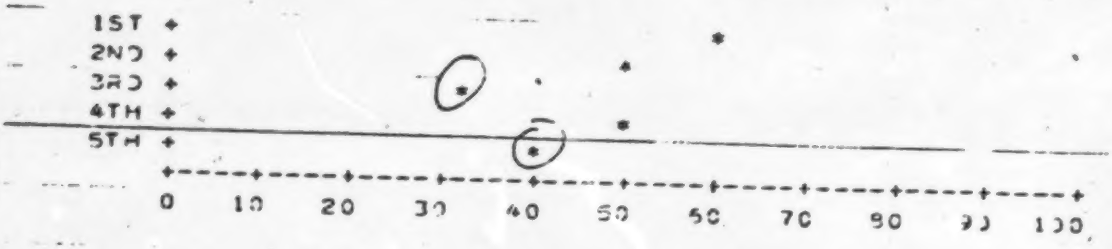
ITEM 22 PERCENT OF CORRECT RESPONSE BY FIFTHS



ITEM 23 PERCENT OF CORRECT RESPONSE BY FIFTHS



ITEM 24 PERCENT OF CORRECT RESPONSE BY FIFTHS



21

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MATRIX OF RESPONSES BY FIFTHS                              C IS CORRECT RESPONSE

          A      B     (C)     D      E      F      G      H      I      J   OMIT
 1ST      4      1     20      0      0      0      0      0      0      0      0
 2ND      2      4     19      1      0      0      0      0      0      0      0
 3RD      1      2     21      0      0      0      0      0      0      0      0
 4TH      7      4     11      1      0      0      0      0      0      0      1
 5TH      3      5      9      7      0      0      0      0      0      0      1

PROP   0.14   0.13  (0.65)  0.07   0.00   0.00   0.00   0.00   0.00   0.00   0.02
RPBI  -0.03  -0.14  (0.34)-0.34   0.00   0.00   0.00   0.00   0.00   0.00  -0.15
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+22

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MATRIX OF RESPONSES BY FIFTHS                              A IS CORRECT RESPONSE

        (A)      B      C      D      E      F      G      H      I      J   OMIT
 1ST     10     14      1      0      0      0      0      0      0      0      0
 2ND      7     18      0      1      0      0      0      0      0      0      0
 3RD      5     16      1      2      0      0      0      0      0      0      0
 4TH     10     13      1      0      0      0      0      0      0      0      0
 5TH      3     21      0      1      0      0      0      0      0      0      0

PROP  (0.28)  0.66   0.02   0.03   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI  (0.15)-0.12    0.04  -0.08   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

+23

```
MATRIX OF RESPONSES BY FIFTHS                              A IS CORRECT RESPONSE

        (A)      B      C      D      E      F      G      H      I      J   OMIT
 1ST     19      1      3      2      0      0      0      0      0      0      0
 2ND     20      1      4      1      0      0      0      0      0      0      0
 3RD     14      0      6      4      0      0      0      0      0      0      0
 4TH      9      3      6      6      0      0      0      0      0      0      0
 5TH      3      1     13      8      0      0      0      0      0      0      0

PROP  (0.52)  0.05   0.26   0.17   0.00   0.00   0.00   0.00   0.00   0.00   0.00
RPBI  (0.49)-0.05   -0.30  -0.26   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

#24

```
MATRIX OF RESPONSES BY FIFTHS                              C IS CORRECT RESPONSE

          A      B     (C)     D      E      F      G      H      I      J   OMIT
 1ST      0     10     15      0      0      0      0      0      0      0      0
 2ND      4      8     13      1      0      0      0      0      0      0      0
 3RD      1     15      8      0      0      0      0      0      0      0      0
 4TH      1      9     12      1      0      0      0      0      0      0      1
 5TH      4      8     10      1      0      0      0      0      0      0      2

PROP   0.08   0.40  (0.47)  0.02   0.00   0.00   0.00   0.00   0.00   0.00   0.02
RPBI  -0.11   0.05  (0.10)-0.04   0.00   0.00   0.00   0.00   0.00   0.00  -0.24
```

APPENDIX A

Although this is not identical to the original printout the underlying theory is the same. In Item 1, 89 percent answered the question correctly. 1) The mean score of 279 (2) candidates was 77.27[3]. The mean score (248[4]) of those who selected C, the answer, was 78.59[5] (above average) those who omit or selected A, B, D ranged from 53.00 to 67.75. The correlation (RBIS) of those selecting the right answer and those scoring high on the test is high .5488[6].

In Item 2, more higher scoring people 79.23 picked the wrong answer A than those who selected B 71.61. Consequently, there is a negative RBIS -0.4661 and this question is suspect.

ITEM 1	RESPONSE	OMIT	A	B	C*	D	TOTAL:			
	N	1.	10.	12.	248. [4]	8.	279. (2)	P+	=	0.889 (1)
	MEAN TEST SCORE	53.00	66.10	67.75	78.59 [5]	67.50	77.27 [3]	RBIS	=	0.5488 [6]

ITEM 2	RESPONSE	OMIT	A	B*	C	D	TOTAL	P+	=	0.1648
	N	1.	219.	46.	2.	11.	279.			
	MEAN TEST SCORE	53.00	79.23	71.61	67.00	65.91	77.27	RBIS	=	-0.4661

APPENDIX B

MT

Item 10	A is a strong response.
Item 22	Twice as many picked B. Especially significant is the fact that twice as many from the top two-fifths picked B.
Item 24	Some good people picked B.
Item 42	Statistically A is a stronger answer than C.
Item 44	B is a strong option.
Item 51	B is a strong distractor. If A is correct it is a good norm referenced question as it distinguishes the top fifth from the other four fifths. If only 1/5 deserves to be certified then it is a good criterion reference test question.
Item 54	B appears to be a better answer than D.
Item 60	B draws as good students as does (C) the answer.
Item 94	D is selected by good candidates, should be looked at as a possible answer.
Item 105	A should be looked as a possible answer.
Item 108	B should be looked at as a possible answer.
Item 110	C should be looked at as a possible answer.
Item 120	A should be looked at as a possible answer.

MLT

Item 23	Look at option B - 7 in 2nd/fifth answered B.
Item 28	Ability level of those selecting A and B not too different from those selecting C.
Item 30	I suspect that item is keyed wrong. Majority of candidates selected B. If A is correct I suspect this is not an appropriate level question for criterion referenced test.
Item 52	Check on D as a possible answer - 10 of top two-fifths answered this correctly.
Item 57	Check for accuracy, C appears to be correct but D attracts good students. Good norm referenced item.
Item 66	More of 3rd/fifth answered correctly. Option A bothered some good students in 1st and 2nd fifth.
Item 72	C attracted good students.
Item 88	B attracted some good students in 2nd fifth.
Item 101	A is a very strong distractor.
Item 102	D should be checked as a possible answer.
Item 103	A should be checked as a possible answer.
Item 108	B and D should be looked at. 10 from the highest 5th picked D and only 1 picked the answer A.
Item 109	D should be checked as a possible answer. As it has a higher correlation with total score than does (C) the answer.
Item 115	A should be checked.
Item 120	B and C should be checked.

Composite of Proctor's Reports

MLT Programs Number of programs participating = 9
Number of programs responding = 8

1. Average length of time for students to complete exam:

Mean = 84 minutes
Median = 77 minutes
Range = 45-110 minutes

2. Did the students appear to understand the instructions?

Yes = 8
No = 0
No response = 0

Comments: None

3. Were the testing facilities adequate?

Yes = 8
No = 0
No response = 0

Comments: None

4. Were there any major complaints about the test which the students brought to your attention?

Yes = 0
No = 7
No response = 1

Comments: Except for a few typographical errors. Students asked if they were permitted to use calculators if problems were on the exam?? Permission was granted.

General Remarks:

In general all was understood. Question #14 asks for total ruling when using a Neubauer chamber--the student questioned why only one side was the answer when both sides (18 sq. mm.) should have been a choice due to the way the question was worded.

I feel question #53 should read V or X if you intent a single factor deficiency. Using and could suggest a double deficiency (granted it's unlikely) and a. would be correct.

Composite of Proctor's Reports

MT Programs
Number of programs participating = 15
Number of programs responding = 14

1. Average length of time for students to complete exam:

Mean = 93 minutes
Median = 90 minutes
Range = 77-105 minutes

2. Did the students appear to understand the instructions?

Yes = 14
No = 0
No response = 0

Comments: They wanted to know if they would receive their grades (?). Also is "school"-- the university they attended or the name of our school?

3. Were the testing facilities adequate?

Yes = 14
No = 0
No response = 0

Comments: None

4. Were there any major complaints about the test which the students brought to your attention?

Yes = 1
No = 12
No response = 1

Comments: Many spelling (errors) in booklet and answer choices.

General Remarks:

It would be better if we would have had more advanced notice when test was to be given.

Very well organized!!

I thought this test was quite good. Student's reaction was favorable.

Students felt it was a good comprehensive exam.

Well organized program of administration. Instructions were clear.

What are examinee ID forms?

Question #61--answers include 2 "c" and no "d". Question #76 -- answers included an "e" and the absence of a "d"

Question # 70--question as to whether adult or child; #60 Fitzgerald spelled wrong; Not enough time for test.

MLT/MT Hematology Proficiency Exam

(as normed by participating MLT/MT programs in New Jersey, April 28, 1981)

	MLT	MT
Programs participating	9	15
Number of students	79	124
Minimum Pass Level (MPL)	76.3	77.4
Norming analysis:		
number of items	120	120
mean score	83.5	74.4
median score	82.6	74.5
std. deviation	13.5	13.3
highest score	110	98
lowest score	49	45

Quintile:	Score Range:	
First	97-110	88-98
Second	85- 96	80-87
Third	80- 84	71-79
Fourth	73- 79	63-70
Fifth	49- 72	45-62